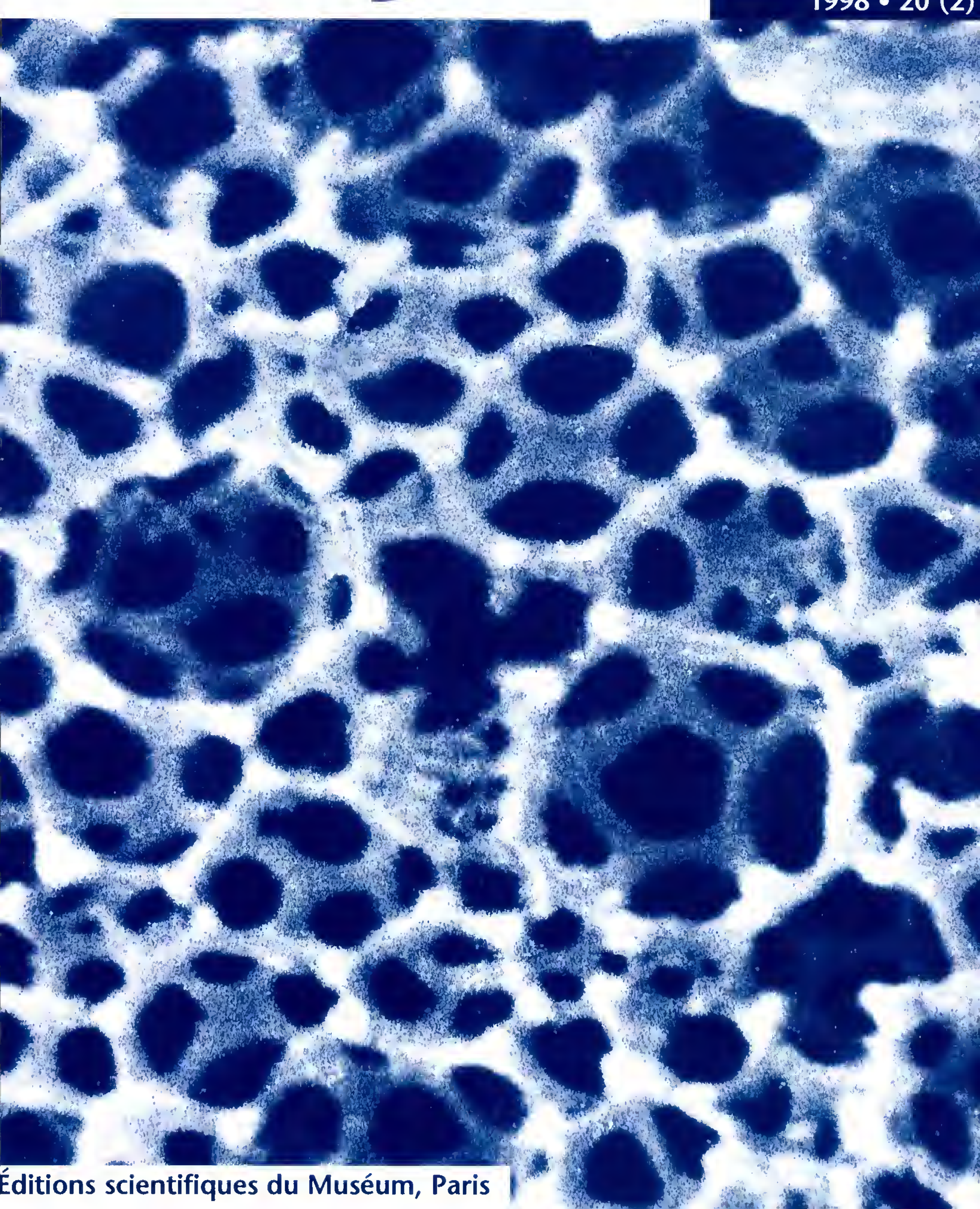
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Papers in honour of Alain Crosnier

Éditeurs invités | Guest editors

Enrique Macpherson, Rafael Lemaitre, Bertrand Richer de Forges & Raymond B. Manning

Les « *Crosnier's cronies* » : par la fenêtre du grenier

Crosnier's cronies and their view from the attic window



Depuis près de deux décennies, de nombreux carcinologistes du monde entier (y compris nous-mêmes) ont escaladé plusieurs fois les quatre étages de l'escalier, fort raide, qui mène au bureau d'Alain Crosnier, au Muséum national d'Histoire naturelle, à Paris. Le souffle repris, accueillis par son sourire habituel, et échangées les amabilités d'usage, Alain nous faisait le point sur les dernières expéditions françaises et nous montrait enfin les centaines d'échantillons impeccablement conservés et étiquetés que nous devions absolument étudier. À la fin de notre séjour, nous avions enfin le privilège d'être admis dans le club des collègues les plus persévérants d'Alain, qu'il a joyeusement baptisé « *Crosnier's cronies* ».

Des beautés parisiennes, nous n'avons pas pu voir grand-chose (excepté par la fenêtre du grenier, un coin de ciel parisien ou un pigeon, effarouché par la vue des chercheurs en plein travail). Mais, après l'examen d'un petit nombre d'échantillons, il devenait évident que les collections que nous étions en train d'étudier constituaient un trésor incomparable : une faune nouvelle et incroyablement diversifiée dépassant toutes nos espérances. Les efforts déployés par Alain pour accumuler, trier, répartir les spécimens et publier les résultats de nos travaux, ont suscité notre reconnaissance aussi bien professionnelle qu'amicale.

Quand nous avons sollicité les auteurs pour obtenir des articles sur les échantillons MUSORSTOM, la réponse a été immédiate et unanime ! Tous se sont accordés pour trouver l'hommage mérité, et très vite, ils ont envoyé leurs manuscrits, fondés une fois encore sur les collections françaises. Notre travail a été aisé. En lui dédiant

For nearly two decades, many carcinologists from around the world (ourselves included) have climbed many times the four floors of steep stairs that lead to Alain Crosnier's office in the Paris museum. Once there, greeted with his usual smile, and the introductory conversation over, and after updating us on the results of the latest French expeditions, Alain showed us the hundreds of impeccably preserved and labeled samples that we absolutely needed to study. At the end of our working visit, we had the opportunity to graduate as one of a select group of Alain's long lasting colleagues, which he playfully called "Crosnier's cronies".

We could not see much of the beauty of Paris (from the lab, through the attic window, only a glimpse of Parisian sky or the occasional startled museum pigeon staring down at busy scientists was possible...), but after examination of a few samples, it became clear that the collections we were studying represented an incomparable treasure chest containing a new and incredibly diverse crustacean fauna that exceeded our expectations. Alain's efforts in amassing, processing and distributing the specimens, publishing the results of our studies, and many years of facilitating the work of specialists, led to the emergence of a professional recognition and friendship towards Alain.

When we solicited written contributions from those who worked with MUSORSTOM samples, the response was swift and unanimous. All colleagues contacted agreed that the honor was needed, and soon thereafter delivered manuscripts, once more based on French

ce volume regroupant des articles illustrant un large éventail de crustacés, écrits par des spécialistes du monde entier, nous souhaitons simplement témoigner à Alain la reconnaissance scientifique internationale qu'il a bien méritée. L'initiative de cet hommage ayant été prise par les collègues étrangers, ils sont majoritaires parmi les auteurs.

La réussite des activités d'Alain tient à la mise en œuvre d'une méthode simple et efficace pour réaliser une recherche de qualité en Systématique. Avec beaucoup de ténacité, il a su trouver des fonds pour les quatre étapes indispensables : (1) la récolte ; (2) le tri et la répartition des échantillons auprès d'un réseau mondial de spécialistes ; (3) la possibilité de séjours rémunérés pour les chercheurs ; (4) la publication des résultats.

Depuis de nombreuses années, Alain a proposé des échantillons de différentes campagnes françaises outre-mer réalisées par lui-même ou d'autres collègues français. Après un long voyage, les échantillons arrivaient à Paris dans de grands fûts et étaient soigneusements triés et étiquetés, principalement par Alain pendant des heures, des jours, des semaines, et parfois des mois. Puis, il recherchait patiemment les spécialistes à qui confier ces échantillons. De telles offres s'accompagnaient généralement d'une aide financière pour venir travailler, un mois ou plus, au MNHN, Paris (Laboratoire de Zoologie-Arthropodes). Si le travail n'était pas terminé à la fin du séjour, les spécimens étaient expédiés chez le spécialiste. Les résultats étaient publiés dans les volumes MUSORSTOM, soigneusement édités par Alain dans les *Mémoires du Muséum national d'Histoire naturelle*. Le financement de ces volumes provenait généralement du gouvernement français mais Alain trouvait, si nécessaire, des fonds complémentaires pour ne pas en retarder la publication. Comme fruit de sa persévérance, plusieurs centaines de nouveaux taxons ont ainsi été décrits par les « *Crosnier's cronies* » dans environ 9 000 pages, 5 000 figures et 200 planches photographiques (dont de nombreuses en couleur), des séries MUSORSTOM dont le volume 20 paraîtra cette année. De plus,

collections, to the editors. Our job was easy. In dedicating this volume of articles dealing with a cross-section of crustacean groups, and written by scientists from around the world, we simply wish to give Alain the public recognition that we believe he well deserves. The cast of authors is predominantly from outside France, as the recognition was primarily intended to be from his international colleagues.

The success of Alain's activities can be attributed largely to the implementation of a simple but effective working strategy for conducting basic systematic research. He has energetically promoted and sought funds to support all four indispensable steps: (1) collecting; (2) accurate sorting followed by distribution of samples to a world-wide network of specialists; (3) remunerated working opportunities for scientists; and (4) publication of results.

For many years, Alain gathered samples from various French overseas expeditions in which he and other French colleagues participated. After a long journey, the samples, arrived in Paris in large drums, and were carefully sorted and labelled, mainly by Alain during hours, days, weeks, and sometimes months. He patiently looked for active specialists from around the world, to whom the samples were offered. Such offers, however, did not come with the prospect of glory alone, but with a supporting grant to work in the Paris Museum (Lab. Zoologie-Arthropodes) for a month or more. If work was not completed at the end of the stay, the specimens were shipped to the home base of the specialist. The results were published in the MUSORSTOM volumes, carefully edited by Alain himself in the *Mémoires du Muséum national d'Histoire naturelle*. Funding for the volumes was largely from French government sources, but Alain found, when necessary, complementary support to permit that the publication of results of MUSORSTOM campaigns was not delayed. It is a tribute to his perseverance that several hundred new taxa (and still counting) have been described so far by Crosnier's cronies, in nearly 9000 pages, 5000 figures, and 200 photographic plates (many in colour), published in the MUSORSTOM series, which will

de nombreuses autres études, fondées sur du matériel français, ont été publiées dans d'autres revues scientifiques, en France et à l'étranger, d'autres sont en cours... Il ne fait aucun doute que d'ici quelques années, le leadership d'Alain et les études qu'il a suscitées auront une influence importante sur nos connaissances de la biodiversité, de la biogéographie et de l'évolution de la riche faune de l'Indo-Pacifique et peut-être même de l'océan mondial. Par ailleurs, la contribution personnelle d'Alain doit être soulignée pour l'étude des crevettes carides en particulier, et plus récemment des crevettes pénéides de l'Indo-Pacifique.

Au nom de tous les participants à ce volume, c'est un plaisir d'exprimer notre gratitude à Alain sous la forme d'articles scientifiques. Avec notre sincère admiration, nous les dédions à notre plus estimé collègue et notre ami très cher.

reach the 20th volume this year. In addition, numerous other studies based on the French material have also been published in other scientific journals in France and abroad, and many more studies are still in progress. There is little doubt that over the coming years, Alain's leadership, and the studies he has promoted, will have a profound impact on our views of the diversity, biogeography and evolution of the rich Indo-Pacific fauna, and perhaps even the world oceans as well. Yet, Alain's own contributions have to be mentioned, on caridean shrimps particularly, and more recently the penaeoid shrimps of the Indo-Pacific.

For all participants in this volume, it is a pleasure to express our gratitude to Alain in the form of scientific articles. With sincere admiration, we dedicate them to a most esteemed colleague and dear friend.

Les éditeurs invités/*the guest editors*

E. Macpherson, R. Lemaitre, B. Richer de Forges, R. B. Manning

New Galatheoidea (Crustacea, Decapoda, Anomura) from hydrothermal systems in the West Pacific Ocean: Bismarck Archipelago and Okinawa Trough

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Baba K. & Williams A. B. 1998. — New Galatheoidea (Crustacea, Decapoda, Anomura) from hydrothermal systems in the West Pacific Ocean: Bismarck Archipelago and Okinawa Trough. *Zoosystema* 20 (2): 143-156.

ABSTRACT

Two anomuran decapod crustaceans of the superfamily Galatheoidea that are new to science are described from hydrothermally active areas of the western Pacific Ocean. *Uroptychus edisonicus* n.sp., family Chirostylidae, from a volcanic crater on Edison Seamount near Lihir Island, Bismarck Archipelago, Papua New Guinea, is the third species of the genus known to occur in hydrothermally active areas, both of the others coming from the North Fiji Basin. The new species is more similar to non-hydrothermal congeners from the Banda Sea and the central North Pacific Ocean than to those known from vent areas. *Shinkaia crosnieri* n.g. n.sp., family Galatheidae, from active hydrothermal areas in the Okinawa Trough and Edison Seamount is placed in the monotypic Shinkaiinae n. subfam. having similarities to the Munidopsinae, but with distinctive characters of its own including carapace shape and ornamenration, very short (or reduced) epipods on the third maxillipeds, features of thoracic sternum, legs, and dense ventral mat of setae.

KEY WORDS
hydrothermal systems,
West Pacific Ocean,
Chirostylidae,
Uroptychus,
Galatheidae,
Shinkaiinae,
Shinkaia,
biogeography.

RÉSUMÉ

Galatheoidea (Crustacea, Decapoda, Anomura) nouveaux des écosystèmes hydrothermaux du Pacifique occidental : archipel de Bismarck et fosse d'Okinawa. Deux crustacés décapodes anomoures de la superfamille des Galatheoidea, nouveaux pour la science, sont décrits de sites hydrothermaux du Pacifique occidental. *Uroptychus edisonicus* n.sp., de la famille des Chirostylidae, provenant d'un cratère volcanique sur le Seamount Edison près de Lihir dans l'archipel de Bismarck en Papouasie-Nouvelle-Guinée, est la troisième espèce du genre connue de sites hydrothermaux, les deux autres provenant du bassin nord-fidjien. La nouvelle espèce est plus proche de ses congénères non-hydrothermaux de la mer de Banda et du nord du Pacifique central que de ceux de sites hydrothermaux. *Shinkaia crosnieri* n.g. n.sp., de la famille des Galatheidae, est originaire des sites hydrothermaux de la fosse d'Okinawa et du Seamount Edison ; elle est placée dans une nouvelle sous-famille monotypique Shinkaiinae, qui présente des ressemblances avec les Munidopsinae, mais aussi des caractères distinctifs propres comme la forme et l'ornementation de la carapace, des épipodites sur les troisièmes maxillipèdes très courts (ou réduits), les caractéristiques du sternum thoracique, des pattes, et un tomentum dense de soies ventrales.

MOTS CLÉS
écosystème hydrothermal,
Pacifique occidental,
Chirostylidae,
Uroptychus,
Galatheidae,
Shinkaiinae,
Shinkaia,
biogéographie.

INTRODUCTION

Exploration of hydrothermal environments continues to disclose species previously unknown to science. On several occasions, scientists diving in the Japanese DSRV *Shinkai 2000* collected and recorded on video tape a number of samples and numerous views of a galatheid decapod crustacean species from hydrothermally active areas of the Okinawa Trough (Fig. 1) (for general locations see Halbach *et al.* 1989; Sakai *et al.* 1990; Hashimoto *et al.* 1995). This same galatheid and an unknown chirostylid decapod crustacean were collected from a submarine volcano by scientists on board the German RV *Sonne* while mapping largely uncharted offshore areas of the Tabar-to-Feni island chain in the New Ireland Basin of Papua, New Guinea from March 11 to April 5 1994 during the Epithermal Deposits Southwestern Pacific Ocean (EDISON) cruise (Herzig *et al.* 1994, charted location). The site of this sampling was a volcanic cone on Edison Seamount south of Lihir Island. The new chirostylid, *Uroptychus edisonicus*, is described and illustrated from the unique representative collected. Specimens of the new galatheid *Shinkaia crosnieri* from both of the above localities are described, illustrated, and identified as a new genus and species in a new subfamily, the Shinkaiinae, placed near the Munidopsinae (Baba 1988).

The sites from which these samples were collected lie more than 4400 km apart. In this region, hydrothermalism associated with calderas at modest depth (< 1500 m) represents a variation from much deeper submarine hydrothermal systems associated with mid-ocean ridge spreading or subduction zones (Takeda & Hashimoto 1990; Hashimoto *et al.* 1995). The Okinawa Trough lies near a juncture of the Eurasian and Philippine plates while the New Ireland Basin lies on the eastern arc of the North Bismarck Plate in the tectonically complex Bismarck Archipelago region (Hamilton 1979, maps on figures 145, 146). The sites thus are in disjunct regions of the northern West Pacific back-arc complex (Galkin 1992).

Abbreviations

JMSTC	Japan Marine Science & Technology Center, Yokosuka (Japan);
MNHN	Muséum national d'Histoire naturelle, Paris (France);
USNM	Holotypes and paratypes of new taxa deposited in the U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USA);
che	Cheliped length, tip of rostrum to ventral articulation with sternum;

cl	Carapace length, tip of rostrum to posterior margin of carapace;
coll.	Collector;
Rpr	Length propodus of cheliped, ventral articulation with carpus to tip of propodal finger, right;
Lpr	Same, left;
P	Pereopod;
Pl	Pleopod;
scl	Short carapace length, base of eyestalk to posterior margin of carapace;
tl	Total length, tip of rostrum to posterior margin of telson plates;
w	Maximum width of carapace.

SYSTEMATICS

Family CHIROSTYLIDAE Ortmann, 1892

Uroptychus edisonicus n.sp.
(Figs 1, 2)

MATERIAL. — **Bismarck Archipelago.** West Pacific Ocean, Papua New Guinea, Edison Seamount, near Lihir Island, 3°19.07'S - 152°34.92'E, 1492 m, RV *Sonne* No. Sbb-1535, 29.III.1994, coll. M. Hannington & I. Jonasson: holotype, ovig. ♀ (USNM 251479).

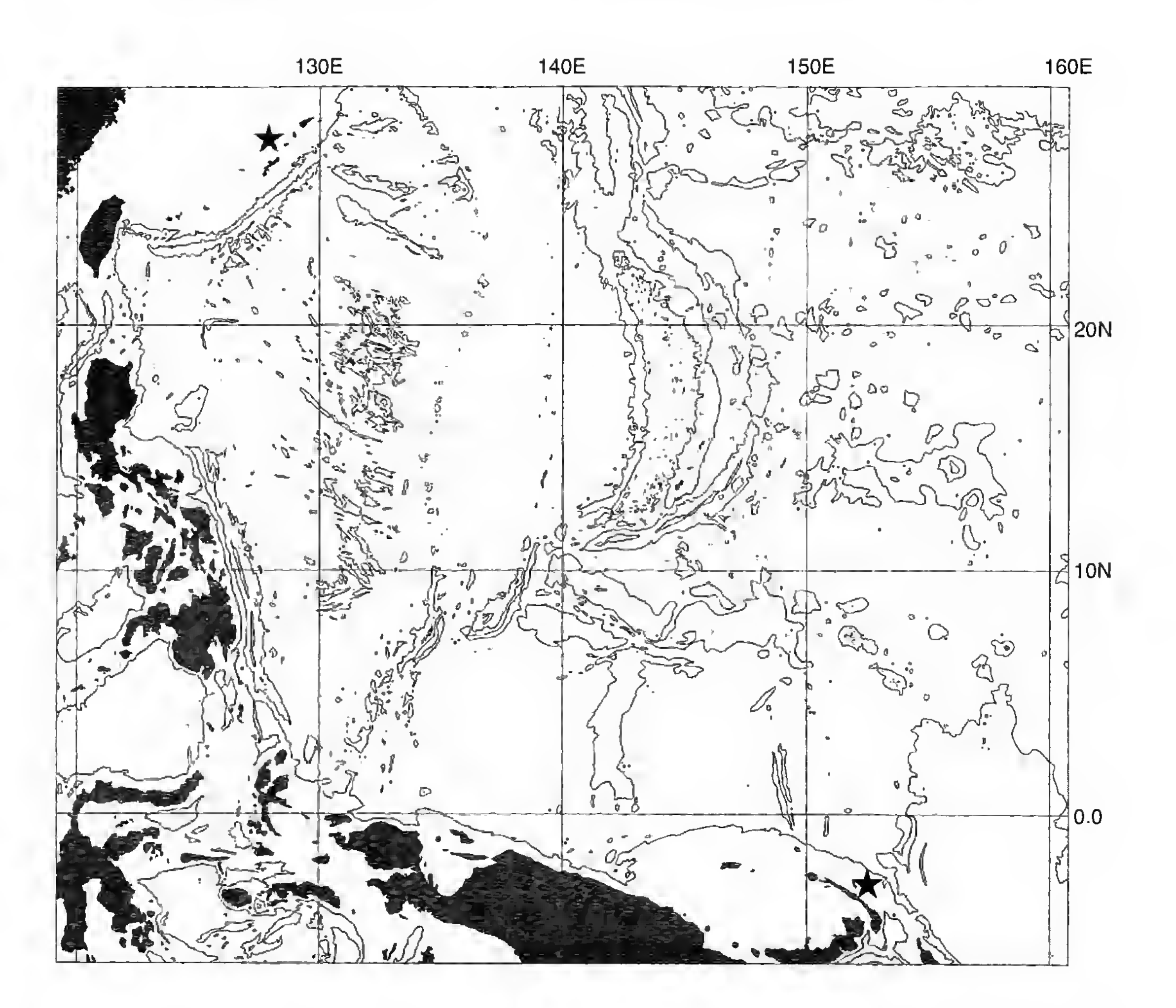


FIG. 1. — Philippine Sea, bathymetry charted at 3000 m intervals, land areas shaded. Bordered on west (left) by Taiwan, Philippine Islands, and south by Papua New Guinea. Sample localities starred, Okinawa Trough upper left, Lihir Island lower right. Base map from British Oceanographic Data Centre (1994).

ETYMOLOGY. — The species is named for Edison Seamount, from which it was collected.

MEASUREMENTS. — cl, 6.24; 5cl, 4.20; chl, 17.5; ova (3 present), 1.28 × 1.39 (in millimetres).

DIAGNOSIS

Carapace dorsally smooth, with sparse short fine setae, lateral margin divergently convex, feebly indented, anterolateral spine small but distinct; greatest width of carapace measured at about posterior one quarter of length excluding rostrum. Rostrum triangular, 0.54 times as long as remaining carapace, not carinate ventrally. Lateral orbital angle acuminate. Eyestalks subcylindrical, barely reaching midlength of rostrum; cornea not dilated, length more than that of remaining eyestalk. Antennal peduncles unarmed on distal two segments, antennal scale reaching end of ultimate segment of peduncle. Third thoracic sternite anteriorly concave, without median notch and spines. Chelipeds relatively slender, unarmed. Walking legs unarmed dorsally; propodi distally broadened; dactyls with prominent, proximally diminishing spines on prehensile margin.

DESCRIPTION

Carapace excluding rostrum shorter than greatest width; dorsal surface convex, smooth, with sparse fine setae, minutely punctate, without ridge along posterolateral margin. Lateral margins convexly divergent posteriorly, spineless except for small but distinct anterolateral spine; greatest width of carapace between insertions of second and third walking legs. Lateral orbital angle acuminate.

Rostrum elongate triangular, 0.54 times postorbital carapace length, one to three asymmetrically arranged spines on each lateral margin tapered distal portion; tip slightly damaged but apparently acuminate.

Sternal plastron wide relative to length; third thoracic sternite concave, without median notch and spines on anterior margin, moderately depressed in ventral view; fourth thoracic sternite with convex, finely denticulate lateral margin. Abdominal segments smooth, glabrous and spineless.

Antennular peduncles with disto-lateral and -mesial processes on basal article simple but well developed. Antennal peduncles with distal article longer than penultimate article, both unarmed; antennal scale slightly broader at base than penultimate article, reaching end of distal article. Third maxillipeds with ischium bearing crest of many (more than 30) corneous spines on mesial ridge, slightly more widely-spaced proximally than distally; merus unarmed on flexor margin, bearing blunt distolateral process; dactyl and propodus densely setose on prehensile surfaces, dactyl spatulate at tip.

Chelipeds smooth, finely setose, length 3.8 times postorbital carapace length; ischium with blunt dorsal process; merus, carpus and palm unarmed; palm slightly wider and 1.3 times as long as carpus, length 4.3 times width; fingers curving ventrad, opposable margins of movable finger with low process somewhat distal to midlength and proximal to smaller opposing process on movable finger.

Walking legs somewhat compressed, smooth and shining, very lightly setose, propodus of first and second distoventrally broadened and spined, third less so, to oppose flexor surface of slightly curved dactyl bearing strong rather evenly-spaced spines on flexor margin, six on first, seven or eight on second and third respectively; length of dactyl/propodus on right side, first walking leg 0.59, second 0.51, third 0.66.

REMARKS

So far only two species of the genus *Uroptychus* are known from active sites of hydrothermal vents: *U. bicavus* Baba *et* de Saint Laurent, 1992 and *U. thermalis* Baba *et* de Saint Laurent, 1992, both from the North Fiji Basin. These are phylogenetically rather remote from this new species in their elongate carapace, the third thoracic sternite bearing two submedian spines on the concave anterior margin, and the short antennal scale. The small anterolateral spine, shapes of the sternal plastron, third maxillipeds and chelipeds, and lack of spines on distal two articles of the antennal peduncles, are similar to *U. setosidigitalis* Baba, 1977 from off Midway Island. The latter species is distinctive in the carapace being smooth on the lateral margins and the walking legs bearing strongly curved densely setiferous dactyls.

The walking legs having propodi distally widened and dactyls armed with strong spines on prehensile margins are also possessed by *U. hamatus* Zarenkov *et* Khodkina, 1981 from the Marcus-Necker Rise, and *U. xipholepis* Van Dam, 1933 from the Banda Sea. The latter two species are characterized by the carapace bearing a row of lateral spines, the chelipeds bearing spines on the merus and carpus, and the antennal peduncles bearing strong spines on the distal two articles.

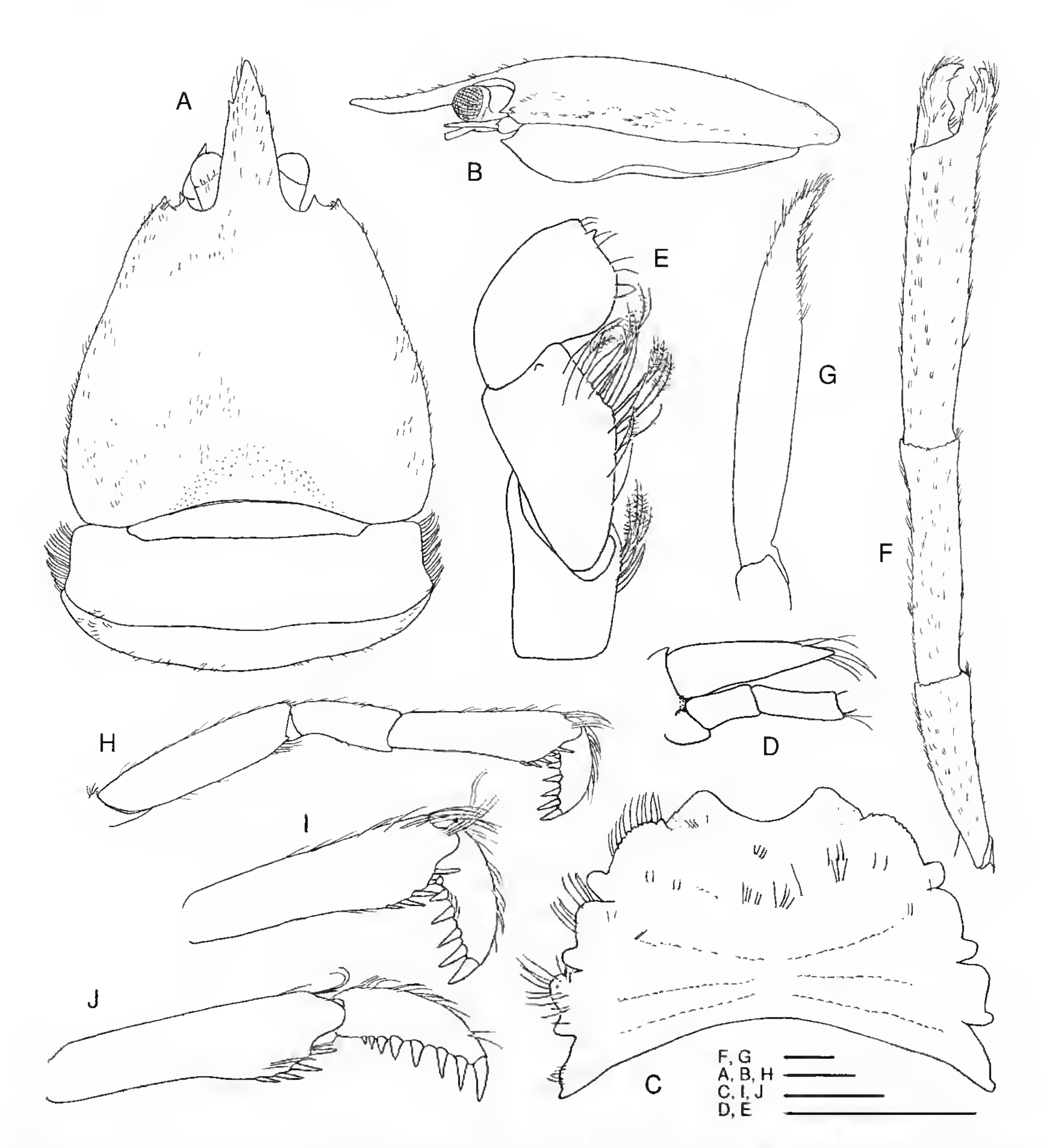


FIG. 2. — *Uroptychus edisonicus* n.sp., holotype ♀ ovig. USNM 251479; **A**, carapace and abdomen, dorsal; **B**, carapace, lateral; **C**, sternal plastron; **D**, right antenna, ventral; **E**, endopod of right third maxilliped (distal two segments omitted), lateral; **F**, right cheliped, dorsal; **G**, chela of same, lateral; **H**, right first walking leg, lateral; **I**, distal segments of same, lateral; **J**, distal segments of right second walking leg, lateral. Scale bars : 1 mm.

Family GALATHEIDAE Samouelle, 1819
Subfamily SHINKAIINAE n. subfam.

DIAGNOSIS
Carapace slightly convex, without grooves on dorsal surface, lateral margins smoothly convex, slightly upturned and bearing many forward trending spines in adults. Strong angle lateral to flattened, immobile basally fused eyestalks with cornea on ventral surface, orbit obscure in dorsal view. Pterygostomian flap anteriorly produced, covering greater part of antennal peduncle. Dense long plumose setae on sternum, pterygostomian flap, and ventral surface of pereopods. Chelipeds strong, broad, depressed and nearly equal, propodal finger bearing ventral longitudinal pit. Walking legs stout and moderately flattened, dactyls bearing prehensile comb of dense corneous setae. Gill formula, ten arthrobranchs, four pleurobranchs, epipods present on maxilliped 3 and legs 1-3. First maxilliped without lash. The subfamily contains only the following genus.

Shinkaia n.g.

TYPE SPECIES. — *Shinkaia crosnieri* n.sp.

ETYMOLOGY. — From the name of the deep submersible *Shinkai 2000*. The gender is feminine.

DIAGNOSIS
Characters as for the subfamily.

Shinkaia crosnieri n.sp.
(Figs 1, 3-6)

MATERIAL. — **Bismarck Archipelago.** West Pacific Ocean, Papua New Guinea, Edison Seamount, northeastern crater rim near Lihir Island, 3°18.85'S - 152°34.92'E, 1483 m, RV *Sonne* No. S29-1531, 20.III.1994, coll. M. Hannington & I. Jonasson: holotype ♂ (USNM 251480); 2 paratypes ♀♀, 1 ovig., 1 newly molted (USNM 251481).
Okinawa Trough, 27°32.7'N - 126°58.2'E, 1394 m, DSRV *Shinkai 2000* Dive/Cruise No. 2K#479, 13.V.1990: 2 paratypes ♂♂ (USNM 251482; JMSTC Ano-0001-90). — 27°16.2'N - 127°04.9'E, 1330 m, 130-200 °C, DSRV *Shinkai 2000*, 10.IX.1988, coll. Masaaki Kimura: 2 paratypes, 1 ♂, 1 ♀ with tip of rostrum cracked (MNHN-Ga 4239). — 27°33.0'N - 126°58.0'E, 1390 m, DSRV *Shinkai 2000* Dive/Cruise No. 2K#672, 14.V.1993: 3 paratypes, 1 ♂, 2 ♀♀, male with abdomen broken, tips of fingers worn on both chelae (JMSTC Ano-0006-93).

MEASUREMENTS. — See table 1.

ETYMOLOGY. — The species is named in honour of Alain Crosnier, eminent decapod crustacean systematist.

DESCRIPTION
Carapace longitudinally oval in dorsal view; lateral margin becoming slightly upturned in large adults, bearing many similar shaped, forward trending, closely-set small spines, one to four anterior to notch demarking anterior branch of cervical groove, larger spine following notch succeeded by 25-30 small spines in unbroken file, though absent from posterolateral part of branchial region, many of them doubled or supernumerary, but poorly developed in young and obsolescent in large adults. Dorsal surface fairly smooth, unevenly ornamented with ciliated punctations, many tending to be associated with obsolescent small transverse rugae, more prominent on flattened peripheral zone than on elevated gastrocardiac region.
Rostrum prominent, flattened dorsally, straplike in outline, margins sometimes slightly bowed laterally at one quarter length, then converging along two-thirds of length, but distal third often rather abruptly triangular with sides bearing five to eight asymmetrically arranged small, anteriorly directed spines (if not obsolescent from wear), ending in subacute distal spinelike tip ornamented with ill-defined circlet of strong subapical setae. Rostral margins merging basally with similarly flattened, concave orbital margins, each flanked laterally by subtriangular antennal spine, slightly sinuous on mesial margin, and with lateral margin leading to tip slightly upturned to form shallowly cupped dorsal surface.
Pterygostomian flap hinged beneath overhanging lateral margin of carapace, generously clothed with long plumose setae set in anterolaterally trending rows of short impressed linear pits, but with anterodorsal surface slightly granular and relatively unciliated; each plate anteriorly subtriangular, with dorsal submarginal longitudinal ridge and tipped by rather acute anterior spine

falling slightly short of plane perpendicular to distal level of antennal peduncle, often with smaller supernumerary spines above tip and one or two below it; ventral margin indented to facilitate free movement of cheliped.

Abdominal segments 2-6 with terga bearing tufts of setae distributed in two transverse rows, terga not transversely ridged; pleura directed laterally, those of segment 2 asymmetrically triangular with rounded tip, pleura of segments 3-5 more or less squared laterally and bearing soft setae ventrally, those of segment 6 narrower and with posterior margin sinuously oblique.

Tailfan bearing long dense setae on distal margin; telson made up of seven unequal platelets, but suggestion of two elongate intercalated platelets between large medial and posterior ones at either side, medial platelets with dense lateral fringe of short setae in male; deep narrow cleft in middle of posterior margin. Uropods broad, large protopod with distal margin scalloped, its mesiodistal lobe bearing obsolescent marginal spines, mesial and lateral rami each with convex lateral margin.

Eyestalks each a dorsally flattened projection nearly as wide at base as rostrum and nestled under rostrum and antennal spine at sides; broadly fused ventral to base of rostrum, shallowly concave and lightly spined on mesial margin; somewhat convex laterally, extending to or



FIG. 3. — *Shinkaia crosnieri* n.sp. clustered *in situ* on rocks associated with hydrothermalism, Okinawa Trough, Ihiya Seamount, 27°32.6'N - 126°58.2'E, 1410 m, DSRV *Shinkai 2000* Dive 366, 12.IX.1988. In addition to the new galatheoids, bresiliid shrimps are seen in lower left hand corner and upper center of picture, others may be hidden. Photo provided by Jun Hashimoto.

TABLE 1. — Measurements of *Shinkaia crosnieri* n.sp. For paratypes JMSTC Ano-0006-93: total lengths of all specimens are approximate because the abdomen is almost impossible to extend to a stable length, and its articulation with the cephalothorax is extremely flexible.

		cl	scl	w	tl	Rpr	Lpr
Holotype							
USNM 251480	♂	37.2	25.8	26.2	60.0	24.9	26.5
Paratypes							
USNM 251481	♀ ovig.	43.7	32.8	30.2	76.5	29.3	29.2
	♀ newly molted	35.9	28.0	28.4	64.0	23.0	22.5
	Egg size (oval), mean of 4 = 3.5 × 4.4						
USNM 251482	♂ heavy fouling	36.3	28.4	25.4	62.2	21.1	16.5
	♂	33.1	26.6	22.3	56.6	20.4	20.0
MNHN-Ga 4239	♀	21.3	16.6	15.9	39.0	10.5	11.0
	♂	13.0	10.2	8.9	21.0	6.2	7.0
JMSTC Ano-0006-93	♀	39.6	31.3	29.5	71.5	22.5	21.0
	♂	52.7	41.2	37.7	86.9	43.0	37.6
	♀	23.4	18.7	16.9	42.5	11.4	12.0

beyond base of triangular rostral tip and bearing one or more strong lateral spines near midlength followed by obsolescent small spines along proximal sector of distolateral margin tapering to acute tip ornamented with ill-defined circlet of strong subapical setae; slender, colorless, transverse band ventrally near base representing vestigial cornea, slightly angular and broadened mesially in ovigerous female, but sometimes interrupted, and apparently obsolescent in large males; part of cornea visible from dorsal and lateral view in some specimens.

Antennular peduncles with strong basal article bearing two well separated slender spines laterally, their tips extending nearly to level reached by tip of lateral spine of eyestalk, lower spine slightly mesial to spine above it. Antennal peduncles with four more or less depressed articles evident; fixed basal article bearing strong lateral spine overreaching articulation with article 2; latter bearing closely appressed triangular flattened lateral spine and two mesioventral spines; article 3 with mesial spine and three spines ventrally on distal margin, partly fused; terminal article extending nearly to level reached by lateral spine of eyestalk; flagellum reaching about to tip of extended cheliped.

Ventral aspect of cephalothorax bearing markedly dense, long, plumose pilosity on proximal articles of Mxp3, coxal, basial, ischial and meral articles of P1-4, and on sternal plates. Epipods present on Mxp3 and P1-3, all short.

Mouthparts as illustrated in Fig. 6. Third maxillipeds with well-developed exopod; articles more or less sculptured, except for propodus and dactyl; dactyl bearing dense terminal tuft of setae, propodus relatively broad and short, with similar terminal tuft; carpus with mesial shoulder bearing dense tuft of setae; sparser mesial tuft on irregularly volute merus and ischium, latter with concave margin bearing small teeth distinct in small specimens especially on distal half, obsolescent in large specimens; denser setae on basis and coxa, latter bearing small mesial spine; epipod short and tapered to acute tip; anterior arthrobranch well-developed, with row of eight palmate lamellae on distal margin, posterior arthrobranch similar, with more numerous lamellae.

Chelipeds (P1) strong, nearly equal. Merus with strong mesiodistal spine, smaller distolateral spine, distodorsal margin bearing widely-spaced tubercles, subdistal dorsal row of about seven irregular small spines continued as setae at either end, largest spine in row near anterolateral corner of dorsal patch of transverse obsolescent

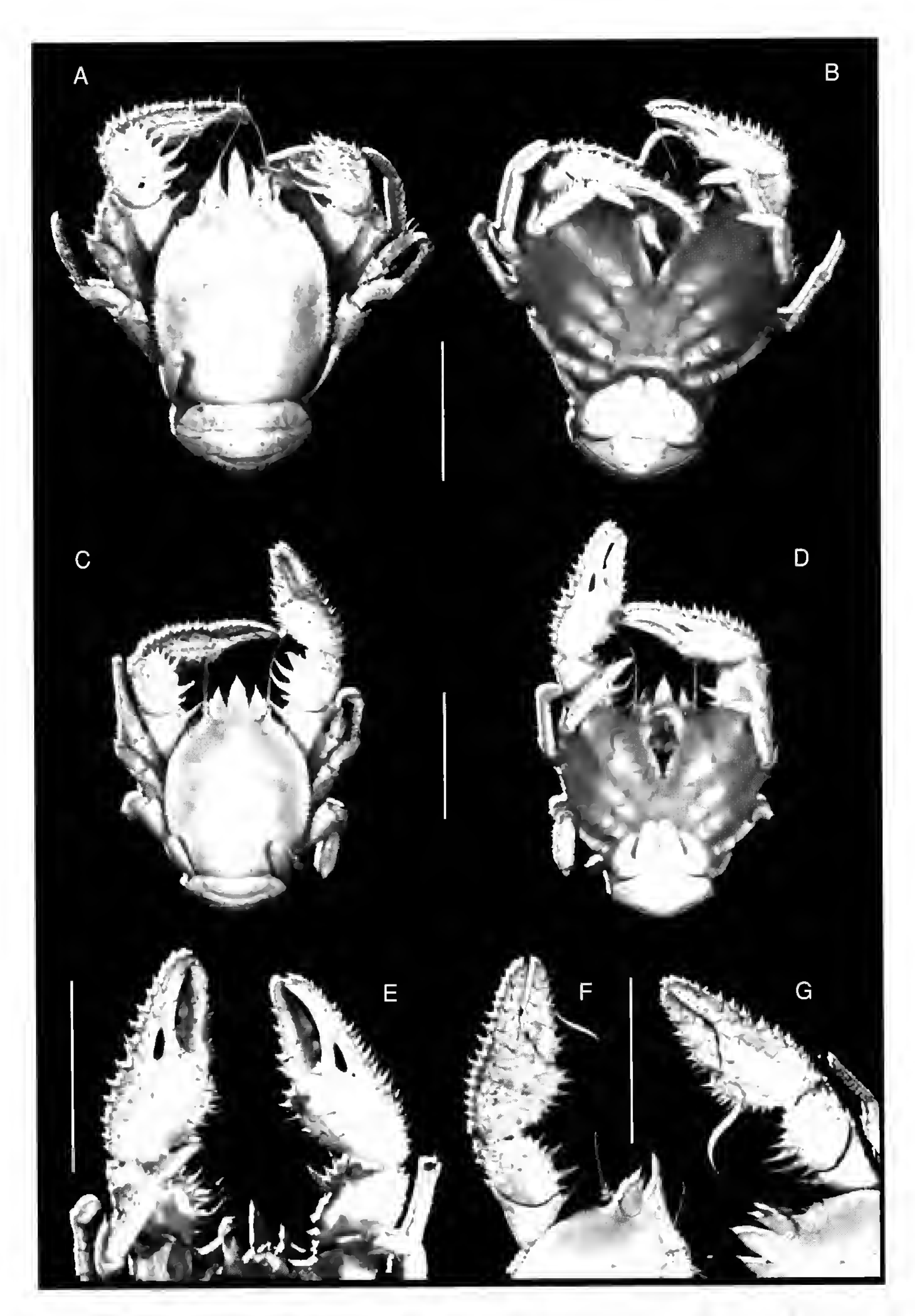


FIG. 4. — *Shinkaia crosnieri* n.sp.; **A**, **B**, paratype ♀, cl. 35.9 mm, USNM 251481; **A**, dorsal; **B**, ventral; **C**-**G**, holotype ♂, cl. 37.2 mm, USNM 251480; **C**, dorsal; **D**, ventral; **E**, chelipeds, ventral; **F**, same, left dorsal; **G**, same, right dorsal. Scale bars: 20 mm.

rugae and setae behind it. Carpus with seven strong mesial spines, curved middorsal longitudinal row of seven spiniform tubercles, spined squames on anterior margin, and tract of about three irregular lateral longitudinal rows of varied small stout spines laterally ending in small antero-lateral spine. Chela with fingers straight, prehensile serrated edges closely approximated in distal five-eighths of length followed proximally by slight gape and molariform tooth near base; palm of propodus bearing crest of seven to eight strong mesial spines, and about seventeen spines laterally along both palm and fixed finger ending in strong curved calcareous tooth at tip, below this row another row of about 15 smaller spines; ventral, deeply excavated longitudinal pit near articulation of dactyl slightly asymmetrical and narrowly obclavate; dactyl with crest of eight to nine varied mesial spines ending in curved tooth at tip, forming with tip of serrate prehensile edge a fork for receiving tip of fixed finger; scattered tufts of setae on all surfaces in rows, set in pits, on spines, or associated with obsolescent rugae.

Walking legs (P2-4) similar to each other in structure; coxa, basis, ischium fringed with setae dorsally, ventrally, and on surfaces adjacent to articular membranes; merus with thick tracts of setae on all surfaces, but setae on carpus, propodus and dactyl confined to tufts emerging from widely spaced pits; dorsal crest of spines on merus, carpus and propodus, those of merus and carpus ending in distally projecting terminal spine; carpus and propodus with dorsolateral crest of smaller spines; less prominent ventral crest of spines on merus ending in strong ventrolateral spine; P3-4 with lateral aspect of merus bearing numerous ciliated pits at base of tubercles, P2 less prominently ornamented laterally; P2-4 carpus and propodus with dorsal crest of eight to ten spines ending in extended distal spine and flanked by dorsolateral row of about nine smaller spines; P2 with thickly scattered low tubercles laterally, but P3-4 with smooth central tract and ventrolateral tract of tubercles; corneous ventral spine often at either distal side of articulation between carpus, propodus, dactyl; dactyls of P2-4 with comb of 17-18 anteriorly trending corneous spines on prehensile edge, strong tip corneous. Chelate P5 much more slender than preceding legs, smoother and folded on itself at merocarpal joint, most noticeable setae in thick cleaning brush on mesial aspect of chela and laterally on distal part of palm and full length of fingers, latter toothless and gaping on prehensile margin, spatulate at tips.

Male with Pl1 gently curved, slender, cylindrical basal article bearing broadened, foliaceous terminal part forking into acute mesial and lateral tips; Pl2 stouter and longer, slender cylindrical basal article bearing elongate oval terminal section consisting of proximal and distal connate lobes, somewhat cupped on anterior aspect but ciliate over convex posterior aspect, longest setae on margin; Pl3-5 much smaller, not obviously biramous. Female with Pl2 smaller than Pl3-5, not obviously biramous.

Discussion

The new species placed in the new subfamily Shinkaiinae has a superficial resemblance to the Porcellanidae in the shape of chelipeds and walking legs, but it apparently fits the definition of the Galatheidae (Borradaile 1907; Balss 1957; Baba 1990), with regard to the: (1) antennular peduncles bearing a strongly spined basal article; (2) antennal peduncles composed of four articles; (3) last thoracic sternite being separated from the preceding sternite; and (4) gill formula (four pleurobranchs, ten arthrobranchs, and an epipod on maxilliped 3).

The reduced eyes and lack of lash on exopods of the first maxilliped indicate that the new species is close to the Munidopsinae, but may be differentiated from that subfamily by the:

– flattish carapace without dorsal grooves;
– strong angle lateral to the flattened immobile eyestalk;
– anteriorly produced pterygostomian flap covering greater part of the antennal peduncle;
– lack of elevated transverse ridges between thoracic sternites 4-7;
– dense plumose setae on the sternum, pterygostomian flap, and ventral surface of legs;
– epipods on the third maxillipeds short, tapering to end, and bearing short setae distally;
– epipods present on pereopods 1-3. Chace (1942), however, pointed out inconsistency in

presence of epipods on legs of *Munidopsis* species. All epipods including those on the third maxillipeds are short and subequal in the present species, but in other galatheids (Galatheinae and Munidopsinae) they are usually elongate and mastigobranchiate on the third maxillipeds, and if present, on the pereopods.

The immobile eyestalks each bearing a transversely subterminal cornea or remnants of it on the ventral surface, and the orbits hardly visible in dorsal view might also be considered to characte-

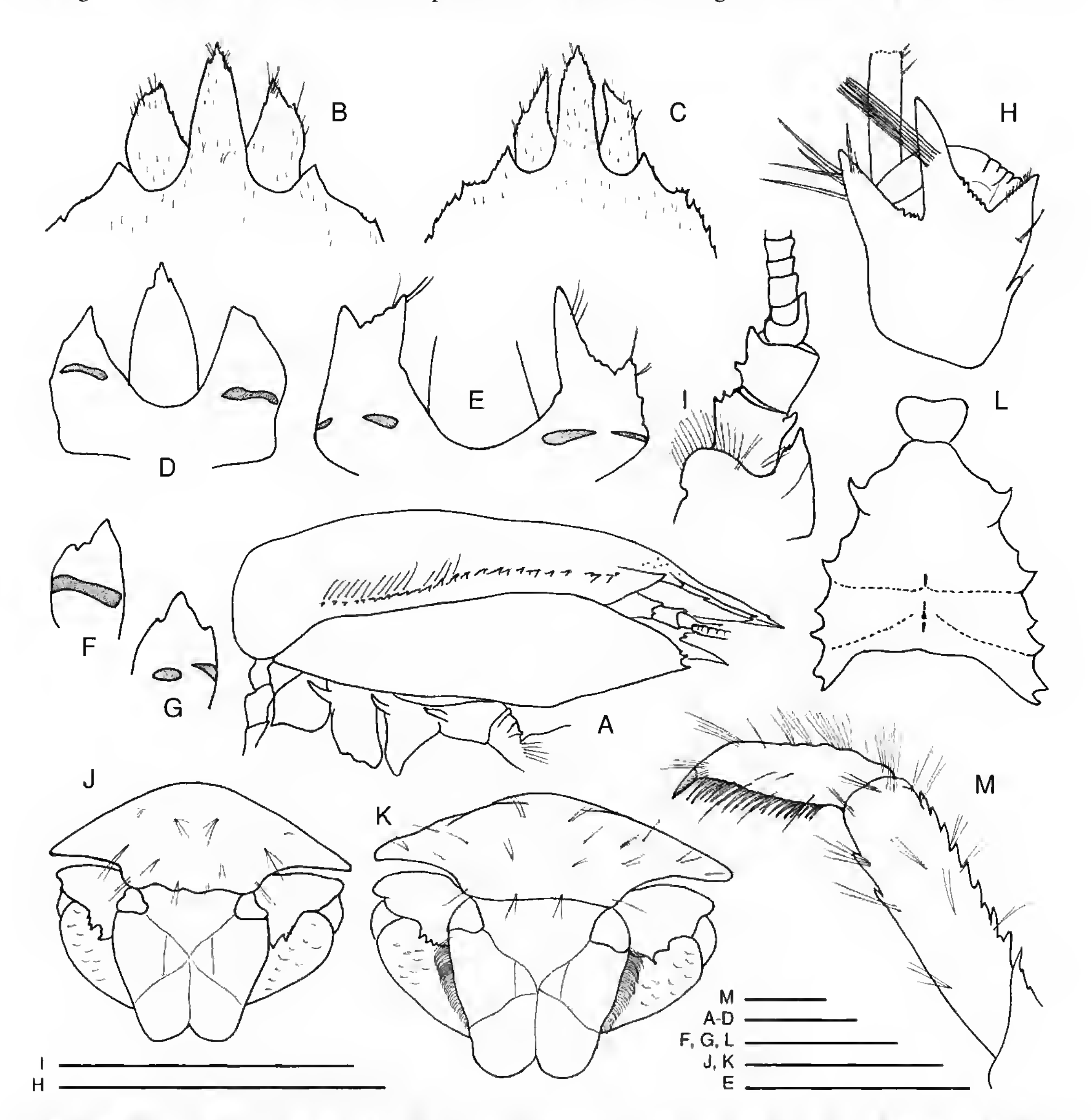


FIG. 5. — *Shinkaia crosnieri* n.sp.; **A**, **C**, **I**, **M**, ♀; **E**, **F** ovig. ♀, paratypes, USNM 251481; **B**, **D**, ♂, **J**, ♀, **K**, ♂, paratypes, JMSTC Ano-0006-93; **F**, **G**, **H**, **L**, ♂, paratypes, JMSTC Ano-0001-90; **A**, carapace and proximal articles of pereopods, right lateral; **B**, rostrum, eyestalks and anterior carapace, dorsal; **C**, same; **D**, rostrum and eyestalks, ventral and slightly tilted toward viewer, cornea lenticular (shaded); **E**, eyestalks and base of rostrum, ventral and slightly tilted toward viewer, cornea discontinuous (shaded); **F**, eyestalks showing variation in shape of cornea, ventral, transverse bar, right; **G**, same, central oval and lateral wedge interrupted, left; **H**, basal antennular article and part of succeeding articles, right; **I**, antennal peduncle, left; **J**, sixth segment of abdomen, telson and uropods, dorsal, ♀; **K**, same, ♂; **L**, thoracic sternum (denuded); **M**, dactyl and propodus, right P2. Scale bars: A-L, 10 mm; M, 4 mm.

rize the Shinkaiinae, but somewhat similar eyestalks are known in *Munidopsis subchelata* Balss, 1913, from west of Sumatra (Balss 1913; Doflein & Balss 1913) [*M. plana* Baba, 1986, from Okinawa Trough appears to be a synonym of this species].

The characters for the subfamily Shinkaiinae listed here fit well within those that define the family Galatheidae; therefore, the key to genera of Galatheidae provided by Baba (1988: 53) can be modified to accommodate *Shinkaia* (the Shinkaiinae) as follows:

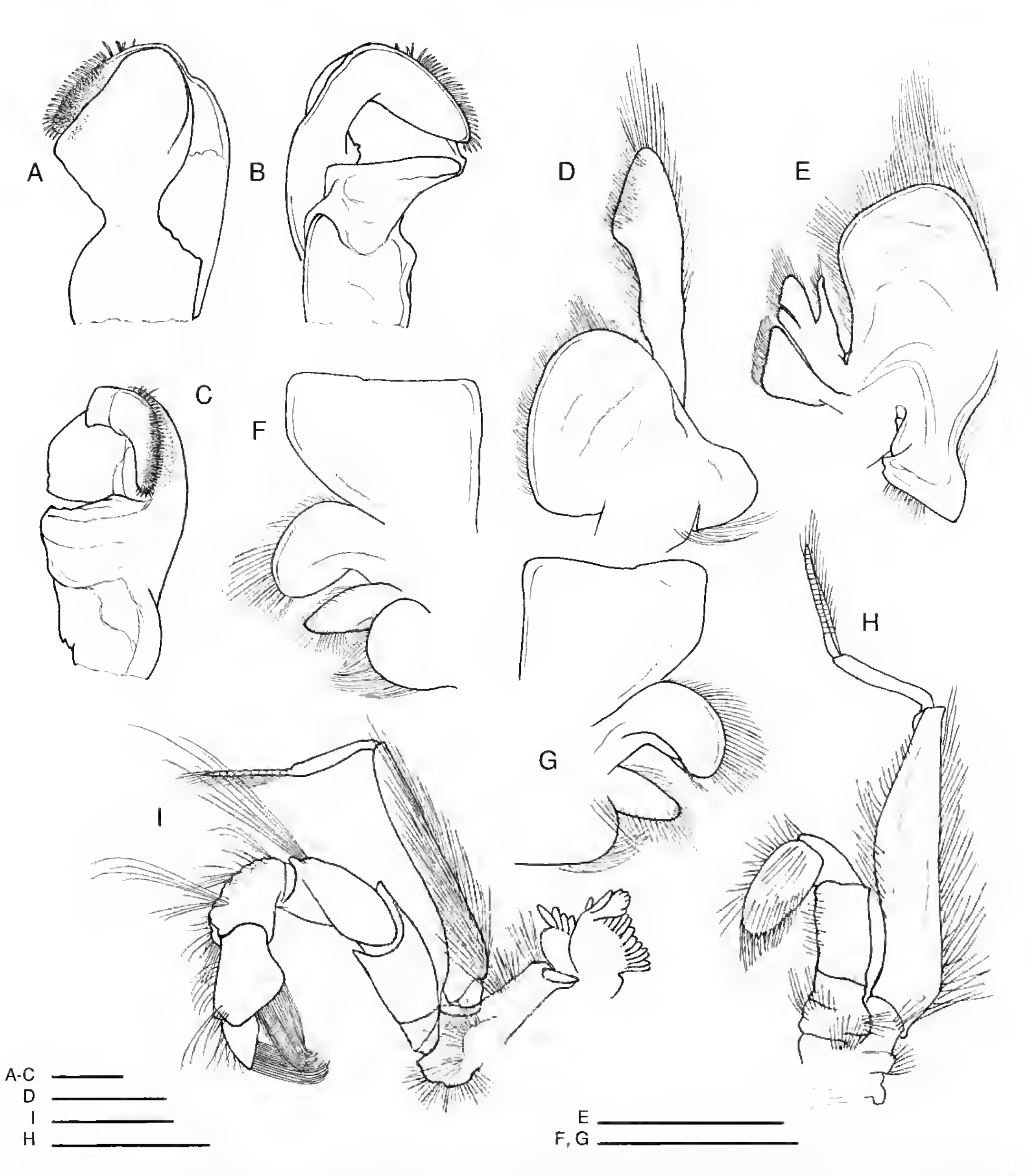


Fig. 6. — *Shinkaia crosnieri* n.sp., mouthparts: **A**-**C**, paratype ♀, USNM 251482; **A**, mandible, left ventral; **B**, same, dorsal; **C**, same mesial; **D**-**I**, paratype ♀, newly molted, USNM 251481; **D**, maxillule, left ventral; **E**, maxilla, left ventral; **F**, first maxilliped, left ventral; **G**, same, left oral; **H**, second maxilliped, left ventral; **I**, third maxilliped, left ventral. Scale bars: A-C, E-G, 10 mm; D, H, I, 4 mm.

1. Eyes usually well-developed; exopod of first maxilliped with lash.. Subfamily Galatheinae

— Eyes usually reduced; exopod of first maxilliped without lash 2

2. Ventral aspect of cephalothorax not clothed with mat of long silky setae .... Subfamily Munidopsinae, *Munidopsis*

— Ventral aspect of cephalothorax clothed with mat of long silky setae .... Subfamily Shinkaiinae, *Shinkaia*

The unusual deeply excavated longitudinal ventral pit on the propodus of each chela of *Shinkaia crosnieri* (Fig. 4) might seem to be unique to the Shinkaiinae, but that is not so. *Munidopsis lentigo* Williams *et* Van Dover, 1983 has a shallower but similar ventral spot on each chela near the articulation of the dactyl. Both of these species are limited to marine hydrothermal environments, so far as known, but Williams & Van Dover noted similar spots on chelae of non-hydrothermal homolid crabs.

Hashimoto *et al.* (1995) gave an excellent ecological and biogeographic summary of faunal elements sampled from marine chemosynthetic communities of southern Japan. Among the latter, the Okinawa Trough is a depression about 100 km wide by 1000 km long. Biological communities reported there by them were discovered on Minami-Ensei Knoll in the central graben of the Okinawa Trough approximately 140 km west of Amami Ohshima Island. Uneven topography in depths, varying from *ca.* 500 to more than 1000 m, suggests volcanic origin. These depths are somewhat less than those from which the reported samples of *Shinkaia crosnieri* were photographed and collected.

There are minor differences among individuals of *S. crosnieri* in samples taken from the Okinawa Trough and those from Edison Seamount, eyestalks and rostrum in the latter tending to be slightly more slender and elongate than in those from the Okinawa region, but measurements of these features overlap in the series as a whole, so there are no clear-cut differences among individuals in these samples that obviously come from widely separated localities on different tectonic plates. Galkin (1992) was well aware of distributional problems concerning isolated hydrothermal communities, but acknowledged evidence of extensive faunistic exchange between individual basins and among mid-oceanic ridge systems. It will be interesting to see if the observed distributional pattern for the new species is sustained when other specimens are collected in this region.

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A new species of the genus *Brachycarpus* (Decapoda, Caridea, Palaemonidae) from New Caledonia

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Bruce A. J. 1998. — A new species of the genus *Brachycarpus* (Decapoda, Caridea, Palaemonidae) from New Caledonia. *Zoosystema* 20 (2): 157-165.

ABSTRACT
A new species of palaemonine shrimp, *Brachycarpus crosnieri*, from Uvea, Loyalty Islands, New Caledonia, is described and illustrated. The new species is readily distinguished from the two other species of the genus by the elongated carpus of its second pereopod. Both Indo-West Pacific species are now known from New Caledonian waters and the new species is also known from Madang, Papua-New Guinea.

KEY WORDS
Brachycarpus,
Crustacea,
Decapoda,
Palaemonidae,
new species,
New Caledonia.

RÉSUMÉ
Une nouvelle espèce du genre Brachycarpus *(Decapoda, Caridea, Palaemonidae) de Nouvelle-Calédonie. Brachycarpus crosnieri*, provenant d'Ouvéa, Îles Loyauté (Nouvelle-Calédonie), est décrite et illustrée. Cette nouvelle espèce se distingue facilement des deux autres espèces du genre par le carpe allongé du deuxième péréopode. Les deux espèces de l'Indo-Pacifique sont maintenant signalées de Nouvelle-Calédonie et la nouvelle espèce est également connue de Madang (Papouasie-Nouvelle-Guinée).

MOTS CLÉS
Brachycarpus,
Crustacea,
Decapoda,
Palaemonidae,
nouvelle espèce,
Nouvelle-Calédonie.

INTRODUCTION

The genus *Brachycarpus* was designated by Bate (1888) in the *Challenger* Report on the Macrura for his species *B. savignyi*. This species was subsequently synonymized by Kemp (1925) with the species originally described as *Palaemon biunguiculatus* by Lucas (1846), based on specimens from Oran and Bône, Algeria. Since then the species has been reported extensively from the warmer waters of the world. It is now sparsely recorded from most of the Indo-West Pacific region, from the Red Sea to Hawaii, most recently from Japan (Okuno & Osawa 1994), and more abundantly from the Eastern Pacific, Eastern and Western Atlantic and western Mediterranean Sea. A second species of the genus, *B. holthuisi*, was later reported from Brazilian waters (Fausto Filho 1966). The discovery of a second Indo-West Pacific species of this genus in New Caledonian waters, where *B. biunguiculatus* (Lucas, 1846) also occurs, is therefore of interest.

ABBREVIATIONS

MNHN Muséum national d'Histoire naturelle, Paris;
CL postorbital carapace length.

Brachycarpus crosnieri n.sp.
(Figs 1-4)

Rhynchocinetes sp. – Allen & Steene 1994: 148 (col. fig.).

Brachycarpus biunguiculatus – Bruce 1996: 4, 5 (partim).

MATERIAL EXAMINED. — **New Caledonia.** Loyalty Islands, Uvea, Passe de la Meurthe, 6-10 m, scuba, 16.XI.1991, coll. J. L. Menou: holotype, ovig. ♀ (MNHN Na.12855).

MEASUREMENTS. — Holotype ♀, postorbital carapace length, 9.0; carapace and rostrum, 18.0; total body length (approx.), 41.5; second pereopod, chela, 11.8; carpus, 8.2; merus, 7.8; length of ovum (advanced), 0.95 (in millimetres).

ETYMOLOGY. — It is a pleasure to dedicate this species to Dr Alain Crosnier in recognition of his great contribution, directly and indirectly, to knowledge particularly of the carcinological fauna of the Indo-West Pacific region, and of his help and friendship over many years.

DISTRIBUTION. — Known only from the type locality, Uvea, Loyalty Islands, and Madang, Papua-New Guinea (Allen & Steene 1994).

DESCRIPTION

Small-sized palaemonid shrimp, of robust subcylindrical body form. Rostrum (Fig. 1A) well-developed, compressed, extending well beyond scaphocerite (Fig. 1B), subequal to carapace length, horizontal, slightly upturned distally; dorsal carina well-developed with seven acute dorsal teeth, first three situated on carapace, first at about 0.5 of carapace length, tip slender, elongate, with single small preterminal dorsal tooth, with sparse interdental median setae, ventral carina with three large acute teeth, distal tooth slightly in advance of antennular peduncle, distal ventral margin with submarginal setae. Carapace smooth, glabrous, antennal spine strong, marginal, hepatic spine smaller, at slightly lower level, at about 0.25 of carapace length; posterior orbital margin (Fig. 1C) marked by low ridge, without knob-like lower termination; pterygostomial angle not produced, bluntly obtuse.

Abdomen (Fig. 1D) smooth, glabrous; third segment not posterodorsally produced, pleura of first three segments large, broadly rounded, fourth and fifth (Fig. 1D) posteroventrally acute; sixth segment about 1.2 times longer than depth, posterolateral and posteroventral angles acute. Telson (Fig. 1H) about 1.5 times length of sixth segment, 2.5 times longer than anterior width, sides sublinear, posteriorly convergent, paired submedian setae anteriorly, with two pairs of subequal dorsal spines at 0.5 and 0.75 of telson length, spines about 0.08 of telson length, posterior margin (Fig. 3I) about 0.3 of maximal anterior width, angular, centrally rounded, with small acute median point, lateral spines small, intermediate spines long, slender, about 0.3 of telson length, two densely plumose submedian setae slightly shorter than intermediate spines, with smaller additional seta on right.

Antennule (Fig. 1F) with proximal segment about 1.25 times longer than wide, distolateral angle strongly produced with long acute lateral

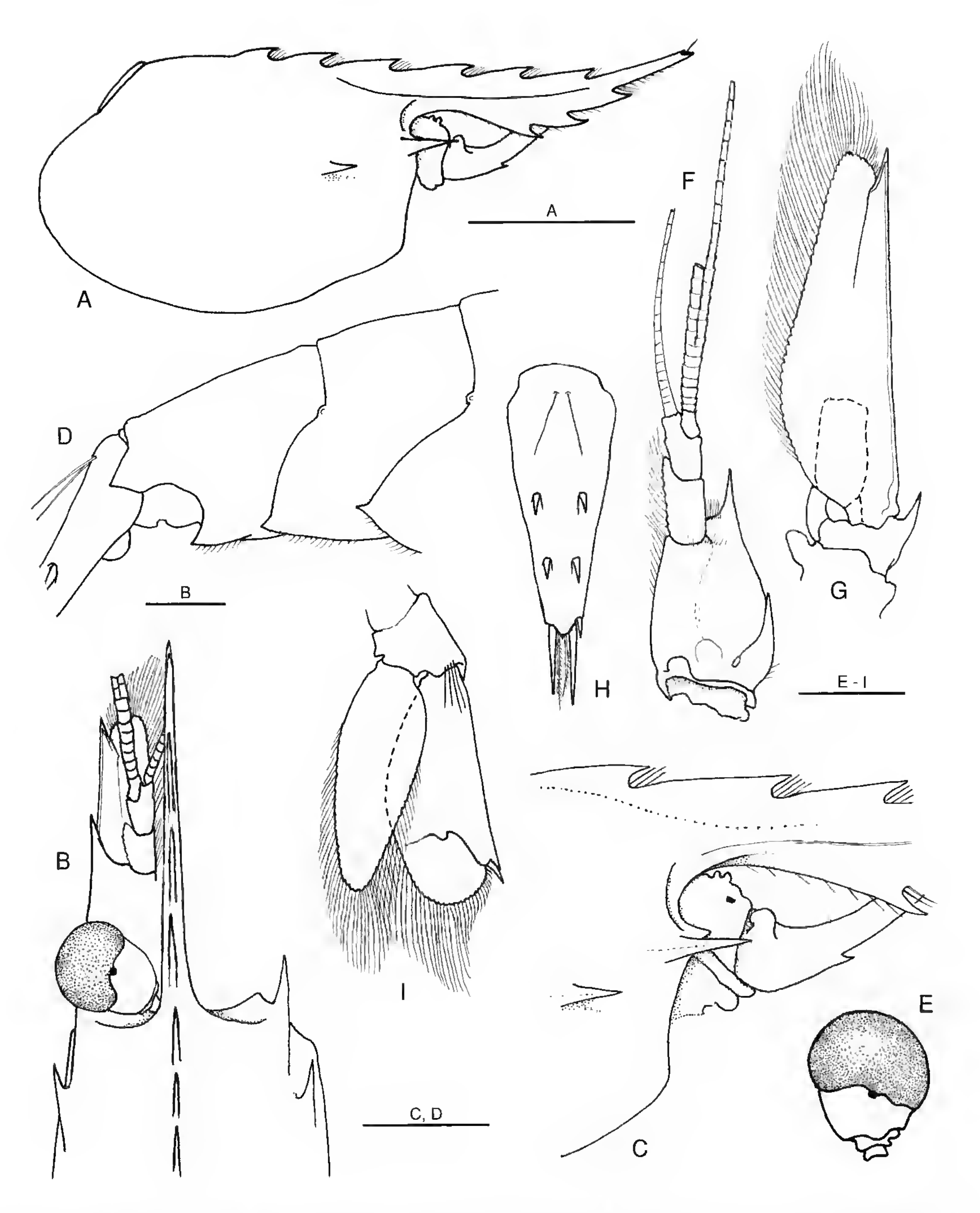


Fig. 1. — *Brachycarpus crosnieri* n.sp., holotype ♀, MNHN Na.12855; **A**, carapace and rostrum, lateral; **B**, anterior carapace and rostrum, left eye and antennal peduncles; **C**, orbital region of carapace, lateral; **D**, posterior abdominal segments, lateral; **E**, eye, right dorsal; **F**, antennule; **G**, antenna, right dorsal; **H**, telson, dorsal; **I**, uropod, right dorsal. Scale bars: A, 5 mm; B-I, 2 mm.

tooth exceeding medial margin of intermediate segment, medially convex, setose, lateral margin convex, with submarginal row of setae ventrally, medial margin less convex, setose, with well-developed acute ventromedial tooth on left side, absent on right, with large boss proximodorsally, statocyst normal, with small granular statolith, stylocerite short, acute, reaching to about 0.5 of segment length; intermediate segment dorsal length about 0.45 of proximal segment length, 1.5 times longer than wide, medially setose, obliquely articulated with distal segment; distal segment subequal to dorsal length of intermediate segment, 2.0 times longer than central width; upper flagellum biramous, proximal nine segments fused, shorter ramus incomplete, with numerous groups of aesthetascs on all except first two segments, longer ramus slender, incomplete, lower flagellum slender, incomplete.

Antenna (Fig. 1G) with basicerite with large acute lateral tooth; carpocerite short, reaching to about 0.33 of scaphocerite length, twice as long as wide, flagellum well-developed, slender, filiform, incomplete; scaphocerite far exceeding antennular peduncle, about 3.4 times longer than wide, greatest width at about 0.3 of length, at level of distal carpocerite, lamella produced, bluntly angular, slightly exceeded by strong distolateral tooth, lateral margin straight.

Eye (Fig. 1E) with large globular wellpigmented cornea, diameter about 0.24 of CL, with small dorsal marginal ocellus; stalk short, broad, twice as wide as long, length about 0.3 of corneal diameter.

Ophthalmic segment (Fig. 1C) with two small median tubercles; median pigment spot distinct. Epistome with median anterior carina, without beak.

Mandible (right) (Fig. 2A) robust, with well-developed slender 3-segmented palp (Fig. 3A), distal segments subequal, about 1.4 times proximal segment length; incisor process short, broad, with three stout teeth distally, cutting edge confluent with molar process; molar process stout, with four blunt teeth. Maxillula (Fig. 2B) with short stout bilobed palp (Fig. 3B), upper lobe slender, sparsely setose, lower lobe stouter, with distoventral tubercle bearing two small spinules (Fig. 3C); upper lacinia slender, distally truncate, with three pairs of short spines distally, and three single spines proximoventrally; lower lacinia short, tapering distally, with numerous spiniform setae distally. Maxilla (Fig. 2C) with sparsely setose tapering palp, basal endite elongate, bilobed, upper lobe longer and stouter than lower, both with simple setae distally; coxal endite obsolete, medial margin feebly convex, non-setose; scaphognathite broad, about 2.2 times longer than wide, posterior lobe large, rounded, about 0.3 of length, anterior lobe distally narrow, medial margin concave. First maxilliped (Fig. 2D) with slender tapering, sparsely setose, dorsomedially concave palp; basal endite large, 1.5 times longer than wide, medial margin with numerous long fine setae; coxal endite medially bicarinate, dorsal carina setose distally, ventral carina setose proximally; exopod well-developed, with long flagellum with numerous plumose setae distally, caridean lobe large; epipod large, deeply bilobed. Second maxilliped (Fig. 2E) with dactylar segment narrow, medial margin with dense fringe of spiniform setae, propodal segment broad, rounded distally, anterior margin with long spines dorsally, long setae ventrally; carpus and ischiomerus normal; basis stout, feebly concave ventromedially, exopod well-developed, with long flagellum with small lateral lamella proximally, with numetous plumose setae distally; coxa strongly produced medially, bicarinate, ventral carina setose, with large simple epipod laterally, bearing well-developed podobranch. Third maxilliped (Fig. 2F) robust, exceeding carpocerite by 0.4 of penultimate segment, ischiomerus fully fused to basis, twisted, distolaterally expanded, dorsal and ventral borders with numerous spiniform setae, exopod well developed, with long flagellum with numerous plumose setae distally; penultimate segment 4.5 times longer than wide, about 0.5 of combined ischiomeral-basis segment length, dorsal and ventral margins with long spiniform setae medially; terminal segment about 0.6 of penultimate segment length, 5.0 times longer than proximal width, tapering distally, with short stout terminal spine, with about twelve trans-verse rows of short spines dorsally, ventral border more feebly spinulate; coxa with small setose ventromedial process, small oval epipod laterally, with two small

arthrobranchs (smaller upper arthrobranch lost from Fig. 2F).

Fourth thoracic sternite with a small slender, very sharp median process; fifth with transverse lamina with small median notch; posterior sternites unarmed. Abdominal sternites unarmed, fifth with feeble median carina.

First pereopod (Fig. 3D) slender, exceeding scaphocerite by 0.2 of carpus; chela (Fig. 3E) with palm subcylindrical, slightly compressed, about 2.3 times longer than central depth, fingers long, slender, with strongly hooked tips, about 1.75 times palm length, with sharp cutting edges throughout length, without teeth; carpus subequal to chela length, about 8.5 times longer than distal width, tapering proximally; merus subcylindrical, subequal to carpus length, with few sparse setae; ischium about 0.5 of merus length, ventrally carinate, with numerous short setae; basis and coxa normal, slender, basis with long setae distoventrally, coxa with rounded distoventral process, fringed with short setae.

Second pereopods well-developed, subequal, similar (see photograph, Allen & Steene 1994). Holotype specimen with only one detached second pereopod preserved (Fig. 3F). Chela (Fig. 3G) about 1.3 times CL, palm smooth, subcylindrical, slightly compressed and tapering distally, about 3.6 times longer than deep, fingers (Fig. 3H) long, slender, sparsely setose, about 10.0 times longer than proximal depth, 1.1 times palm length, with strongly hooked tips, dactylus with two very small teeth at 0.25 of length, opposing single similar tooth on fixed finger, anterior cutting edges sharp, entire; carpus subequal to CL, 8.0 times longer than distal width, 1.65 times palm length, distally slightly expanded, unarmed; merus about 0.9 of carpus length, 9.0 times longer than width, unarmed; ischium 0.5 of carpus length, 5.0 times longer than distal

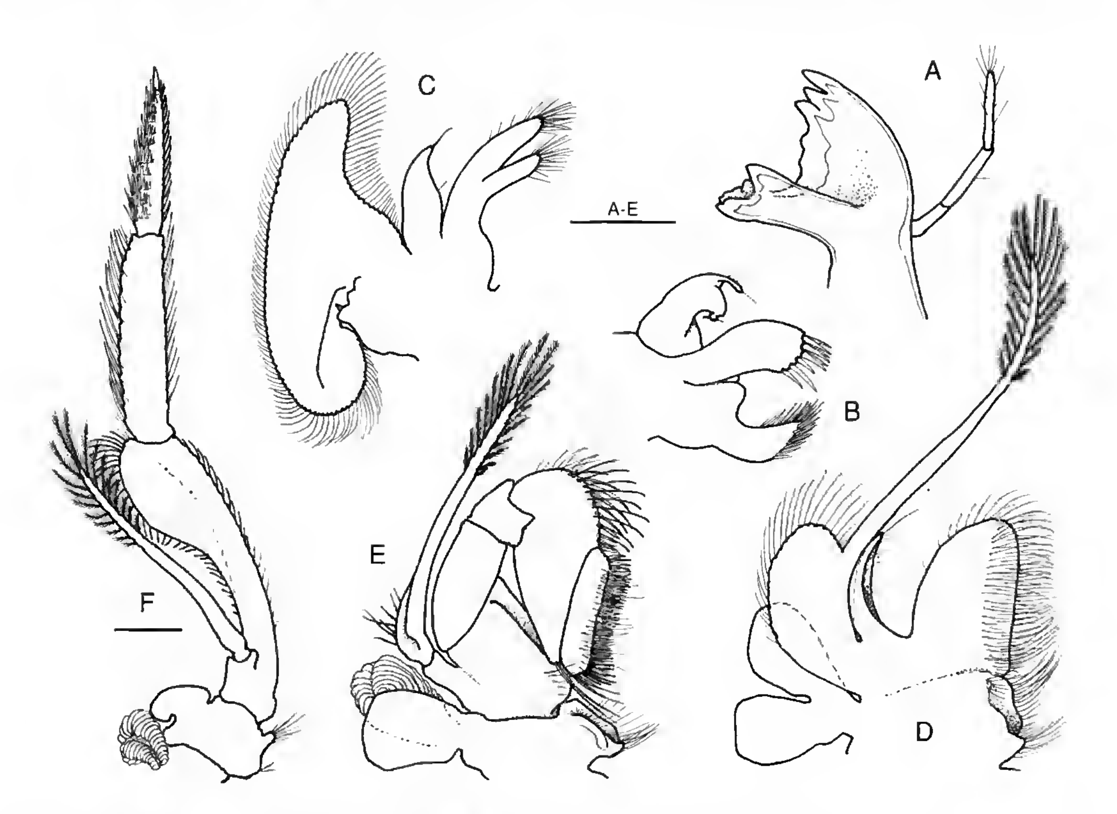


FIG. 2. — *Brachycarpus crosnieri* n.sp., holotype ♀, MNHN Na.12855, right mouthparts, ventral; **A**, mandible; **B**, maxillula; **C**, maxilla; **D**, first maxilliped; **E**, second maxilliped; **F**, third maxilliped, lateral. Scale bars: 1 mm.

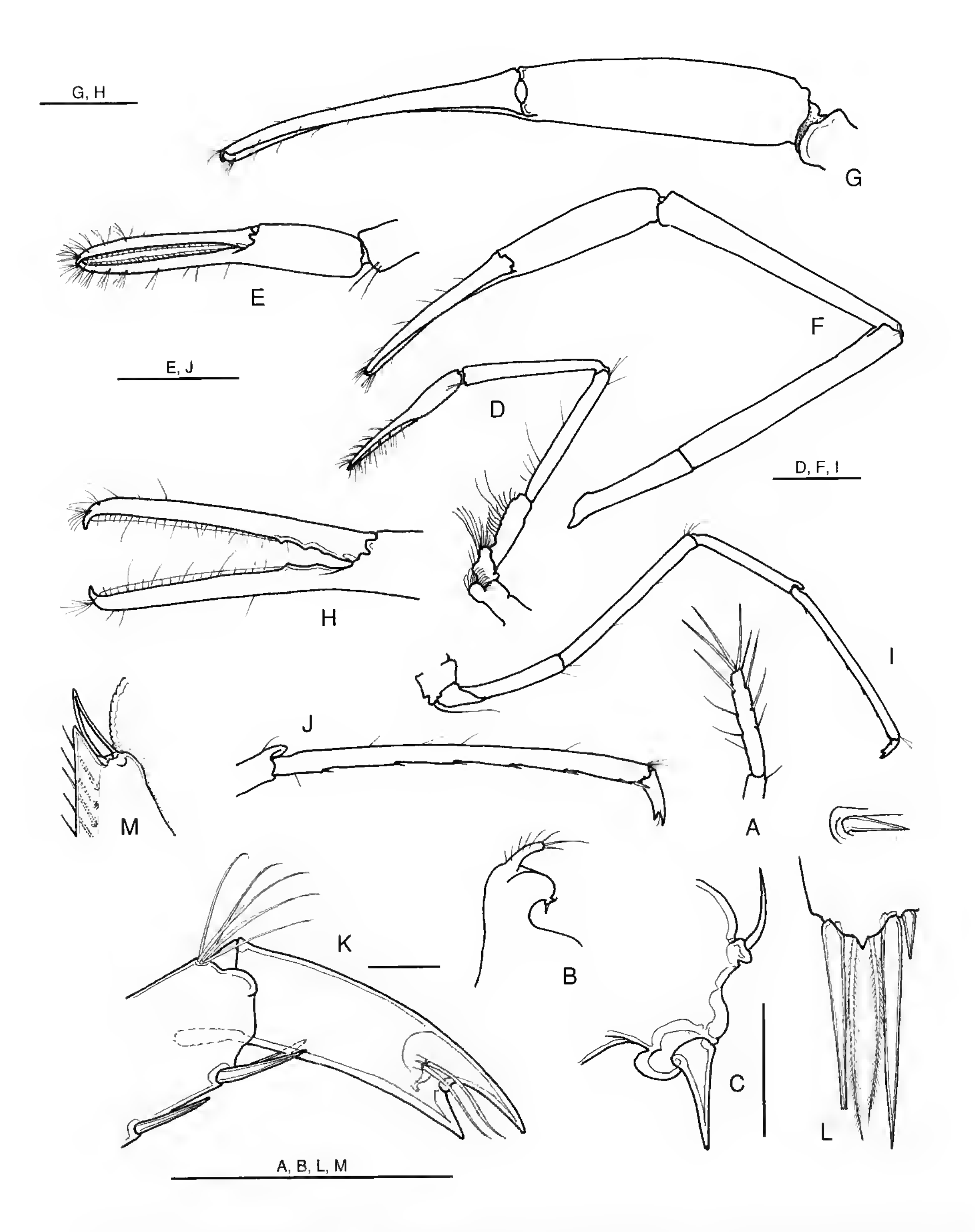


FIG. 3. — *Brachycarpus crosnieri* n.sp., holotype ♀, MNHN Na.12855; **A**, mandible, distal segment of palp; **B**, maxillula, palp; **C**, same, distal end of lower lobe; **D**, first pereopod; **E**, same, chela; **F**, second pereopod; **G**, same, chela; **H**, same, fingers; **I**, third pereopod; **J**, same, first pereopod and dactyl; **K**, same, distal propod and dactyl; **L**, posterior telson spines, dorsal spine inset above; **M**, uropod, distolateral right exopod. Scale bars: A, B, G, H, L, M, 2 mm; C, 0.1 mm; D, F, I, 3 mm; E, J, K, 0.2 mm.



FIG. 4. — *Brachycarpus crosnieri* n.sp., holotype ♀, Uvea, New Caledonia, MNHN Na.12855. Photo by J.-L. Menou.

width, tapering proximally, unarmed. Basis and coxa without special features.

Third pereopod (Fig. 3I) slender, exceeding scaphocerite by half propod length; propod equal to 0.62 of CL; dactyl (Fig. 3K) with unguis fused to corpus, unguis not cornified, about 2.7 times longer than basal width, 0.33 of dorsal corpus length, corpus compressed, about 2.8 times longer than deep, dorsal and ventral margins subparallel, with paired setae distolaterally, dorsal border devoid of setae, ventral margin with stout acute distal accessory tooth, about 0.5 of ungual tooth length; propod (Fig. 3J) about 6.5 times dactyl length, 21 times longer than central depth, sparsely setose, with paired distoventral spines, about 0.4 of dactylar corpus length, six evenly spaced similar ventral spines; carpus about 0.6 of propod length, unarmed; merus subequal to propod length, about 12 times longer than central depth, unarmed; ischium slightly shorter than carpus, unarmed; basis and coxa normal, coxa with small ventral process with single long seta. Fourth pereopod similar, propod about 0.65 of CL. Fifth pereopod similar, with propod 0.76 of CL, without transverse rows of cleaning setae distally.

Pleopods without special features.

Uropod (Fig. 1I) with protopod distolaterally acute (?, slightly damaged), with several long simple setae distodorsally; exopod about 2.5 times longer than central width, lateral margin straight, submarginally setose ventrally, distally with small acute tooth, with large mobile spine medially (Fig. 3M); endopod subequal to exopod length, about 2.7 times longer than maximal width.

General coloration (Fig. 4) a uniform light reddish, including rostrum, antennal peduncles and flagella, and pereopods, with conspicuous darker reddish bands transversely across each abdominal segment posteriorly, paler anteriorly, caudal fan uniform (see Allen & Steene 1994).

SYSTEMATIC POSITION

Brachycarpus crosnieri closely resembles and is closely related to both the other species of the genus, *B. biunguiculatus* (Lucas) and *B. holthuisi* Fausto Filho. It can be readily distinguished from

both by the much more elongate carpus of the second pereopods, which is particularly short in *B. biunguiculatus*, hence the generic name.
The postorbital carina is simple in both *B. holthuisi* and *B. crosnieri*, but is provided with a very characteristic abruptly rounded lower end in *B. biunguiculatus* (Fig. 5).
The mandibular palp is well-developed in both Indo-West Pacific species, but is remarkably reduced in the Brazilian species, which also has the fourth pleuron bluntly angled, whereas it is acutely produced in both other species. The mouthparts of *B. crosnieri* closely resemble those of *B. biunguiculatus* as illustrated by Schmitt (1939).

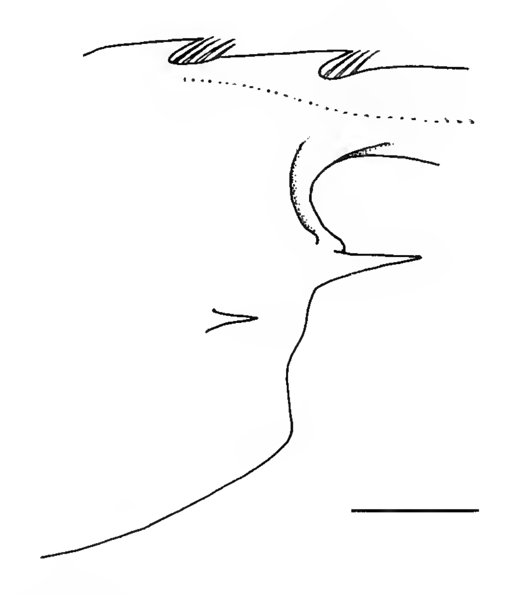


Fig. 5. — *Brachycarpus biunguiculatus* (Lucas), ♀, CL 10 mm, Latham Island, Zanzibar. Anterior carapace, orbital region. Scale bar: 2 mm.

Key to the species of *Brachycarpus* Bate

1. Second pereopod carpus long and slender, *ca.* 1.6 times palm length (rostrum far exceeding antennular peduncle and scaphocerite); rostral dentition 3 + 4/3 .... *B. crosnieri* n.sp.

— Second pereopod carpus shorter, not exceeding palm length (rostrum not exceeding antennular peduncle and scaphocerite) 2

2. Second pereopod carpus distinctly shorter than palm length; dorsal telson spines subdorsal; rostral dentition 2-3 + 5-4/3-4 .... *B. biunguiculatus* (Lucas)

— Second pereopod carpus subequal to palm length; dorsal telson spines lateral; rostral dentition 2+6/2-3 .... *B. holthuisi* Fausto Filho

Remarks

At present the subfamily Palaemoninae contains only seventeen genera and, of these, *Brachycarpus* is the only one to possess biunguiculate dactyls on the adult ambulatory pereopods. In contrast, the numerous genera of the subfamily Pontoniinae have the majority, which are generally commensally associated with other marine invertebrates, provided with biunguiculate or even more ornate dactyls on these appendages. These are presumably related to their commensal life-style. There is no indication of a commensal life-style in the case of *Brachycarpus* species, or of any other member of the Palaemoninae, and most of the Pontoniinae with simple dactyls are probably free-living micropredators or browsers. However, *B. biunguiculatus* has been reported from high energy situations, *i.e.*, reef front surge channels (Holthuis 1953; pers. obs.). No other palaemonine shrimps occur in these habitats. In these situations stout biunguiculate ambulatory dactyls would be of considerable use in maintaining station when exposed to forceful, rapidly changing conditions of water flow. Other palae-

monine shrimps are generally found in less violent or even static waters, where such a feature would be redundant.

In addition to its morphological characters, *B. crosnieri* may also be distinguished from *B. biunguiculatus* by its colour pattern in life, with conspicuous transverse red bars across the abdominal terga, which are not present in the latter species (Okuno & Osawa 1994; Bruce 1996), and apparently also absent from *B. holthuisi*, which is described as uniformly coloured (Fausto Filho 1966).

Brachycarpus biunguiculatus has also been reported from Uvea, Loyalty Islands, from the North Pleiades Islands, also collected by J.-L. Menou (Bruce 1996): the precise habitats of both species were not recorded. The present specimen was overlooked during the examination of some *B. biunguiculatus* specimens, so it is possible that some reports in the literature of that species may refer to specimens of *B. crosnieri*.

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A new coral inhabiting barnacle of the genus *Chionelasmus* (Cirripedia, Balanomorpha) from New Caledonia, Southwest Pacific

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Dans le champ de l'observation,
le hasard ne favorise que les esprits préparés.
(Louis Pasteur, 1854)

Buckeridge J. S. 1998. — A new coral inhabiting barnacle of the genus *Chionelasmus* (Cirripedia, Balanomorpha) from New Caledonia, Southwest Pacific. *Zoosystema* 20 (2) : 167-176.

KEY WORDS
Chionelasmus,
Eolasmatinae,
Balanomorpha,
Cirripedia,
New Caledonia,
Southwest Pacific.

ABSTRACT
This paper describes *Chionelasmus crosnieri* n.sp., from a guyot on the northern part of Norfolk Ridge, to the south of New Caledonia. This new species, within the previously monospecific genus *Chionelasmus*, inhabits a living octocoral, *Muricides* sp. indet. Comments on the distribution and habitat of the new species are provided, including a proposal for the method by which the cyprid larva of *C. crosnieri* gained access to the axial skeleton of the octocoral.

MOTS CLÉS
Chionelasmus,
Eolasmatinae,
Balanomorpha,
Cirripedia,
Nouvelle-Calédonie,
Sud-ouest Pacifique.

RÉSUMÉ
Une nouvelle balane de Nouvelle-Calédonie du genre Chionelasmus *(Cirripedia, Balanomorpha) associée à un octocoralliaire.* Le genre *Chionelasmus* était jusqu'à présent considéré comme monospécifique et *Chionelasmus crosnieri* n.sp. est maintenant décrite du Banc Éponge, un guyot de la partie septentrionale de la Ride Norfolk, au sud de la Nouvelle-Calédonie. Cette nouvelle espèce est associée à un octocoralliaire du genre *Muricides* et le mode de pénétration de la larve cypris vers son squelette axial est discuté.

INTRODUCTION

The first known species of *Chionelasmus*, *C. darwini* was described by Pilsbry (1907), from 417-430 metres off the Hawaiian Islands. Since that time, the distribution of the genus has been extended to the Indian Ocean (Nilsson-Cantell 1928; Yamaguchi 1998), and the Southwest Pacific (Kermadec Islands) (Foster 1981). The fossil record is now known to extend back to the Eocene (Buckeridge 1983; 1993). This paper examines further living material, recovered by Bertrand Richer de Forges, from the northern part of the Norfolk Ridge.

The specimens studied here are preserved in alcohol, and have been examined with the aid of microscopy and dissection. In addition to scanning electron microscope photographs of the exterior of the holotype, illustrations of opercula, mouth parts and appendages have been drawn with the aid of a camera lucida.

The holotype MNHN-Ci 2685, and paratypes MNHN-Ci 2686 to Ci 2688 inclusive, are deposited in the Muséum national d'Histoire naturelle (MNHN), Paris, France; a further paratype, CAX 118, is held in the type collections at the UNITEC Institute of Technology, Auckland, New Zealand.

SYSTEMATICS

Subclass CIRRIPEDIA Burmeister, 1834
Order SESSILIA Lamarck, 1818
Suborder BALANOMORPHA Pilsbry, 1916
Superfamily CHIONELASMATOIDEA Buckeridge, 1983

Family CHIONELASMATIDAE Buckeridge, 1983

DISTRIBUTION. — Upper Palaeocene to Eocene (New Zealand); Recent, 207-1180 m (Pacific Ocean).

DIAGNOSIS

Shell of six primary wall plates: rostrum (R), carina (C), and two pairs of dedicated latera, rostrolatera (RL) and carinolatera (CL), all in contact with the substrate and surrounded by distinctly separate whorl(s) of basal imbricating plates; sheath formed by R, C and CL; RL not entering sheath; basis thinly calcareous.

REMARKS

The exclusion of the RL from the sheath is a useful indication of antiquity, being characteristic only of the Chionelasmatoidea and the most primitive Pachylasmatoidea: *Waikalasma, Eolasma* and *Pachylasma* (Buckeridge 1996a, b).

Genus *Chionelasmus* Pilsbry, 1911

TYPE SPECIES. — *Chionelasmus darwini darwini* (Pilsbry, 1907). Recent, 207-450 m, North Pacific Ocean.

SPECIES INCLUDED. — Two living species are presently attributed to this genus, one being further divided into two subspecies: *Chionelasmus darwini sensu stricto* (Pilsbry, 1907), North Pacific Ocean (207-450 m); *Chionelasmus darwini* n.subsp. (Yamaguchi, 1998), Indian Ocean (420-526 m); plus the new species described here: *Chionelasmus crosnieri* n.sp., Southwest Pacific Ocean (505-1180 m).

DISTRIBUTION. — Upper Palaeocene to Eocene (New Zealand); Recent, 207-1180 m (Indian and Pacific Oceans).

DIAGNOSIS

Chionelasmatinae with trimorphic basal imbricating plates, which, although attributable to up to four whorls, are integrated into one.

REMARKS

Chionelasmus differs from *Eochionelasmus* Yamaguchi, 1990 primarily in the nature of the imbricating whorls (Yamaguchi & Newman 1990). In *Eochionelasmus*, there are between five and nine distinct whorls of imbricating plates, however these plates are monomorphic, lacking the alar extensions characteristic of *Chionelasmus*.

Chionelasmus crosnieri n.sp.
(Figs 1-5)

MATERIAL EXAMINED. — **New Caledonia.** BERYX 11: stn CH02, 24°57'S - 168°21'E, 505-600 m, 14.X.1992: 5 specimens attached to a decorticated octocoral. — Stn CHO5, 24°54'S - 168°22'E, 600-650 m, 15.X.1992: 8 specimens embedded in the living octocoral *Muricides* sp. indet.

RECORD. — Foster (1981: 354), 1180 m. Material lost, opercula and body parts not figured by Foster (*loc. cit.*).

TYPE SPECIMENS. — Holotype, MNHN-Ci 2685: complete shell, with complemental male on operculum, from stn CH05 (Fig. 1); soft tissue removed and prepared for drawing and SEM photography. Paratypes: MNHN-Ci 2686, one complete shell, from stn CH05, with soft tissue and opercula removed; MNHN-Ci 2687, 5 specimens, 4 complete, from stn CH05; MNHN-Ci 2688, 5 specimens, 4 complete from stn CH02; CAX 118: 1 specimen from stn CH05.

ETYMOLOGY. — The new species is named to honour Dr Alain Crosnier, ORSTOM (Institut Français de Recherche Scientifique pour le Développement en Coopération), Muséum national d'Histoire naturelle, Paris. On two separate occasions, 1993 and 1996, I have had the privilege of working in Paris with Alain. He is one of a special breed of scientists, who through scientific rigor, professionalism and dedication, leaves a legacy with ORSTOM that is unlikely to be equaled. I am proud to be able to call Alain both a much respected colleague in science, and a friend.

HABITAT. — Stations CP CH02 and CH05 are located on the flat, limestone capped summit of a large guyot, known as Seamount B, or "Sponge Bank". Seamount B is part of a lineament of guyots at the northern part of Norfolk Ridge, to the south of New Caledonia. Water temperatures at 600 metres are 10-12 °C. In addition to stylasterids, and octocorals with cirripedes, the site is known for a very rich and diverse sponge fauna, including lithistids, tetractinellides, demonsponges. More than 190 invertebrate species have been recorded from the site (Bertrand Richer de Forges, pers. comm.).

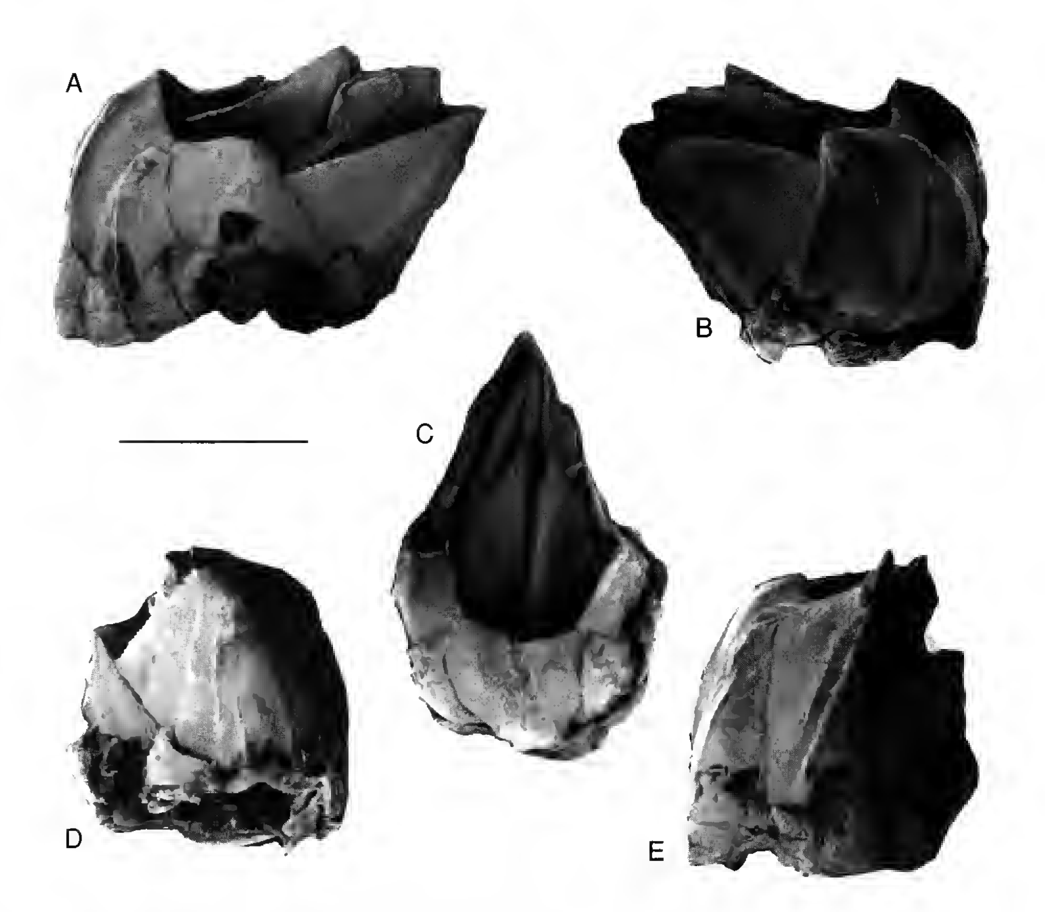


FIG. 1. — *Chionelasmus crosnieri* n.sp., holotype, MNHN-Ci 2685; **A**, lateral view of whole specimen, with complemental male attached near apex of tergum (right side); **B**, lateral view of whole specimen (left side); **C**, dorsal view of whole specimen; **D**, carinal view of whole specimen; **E**, rostral view of whole specimen. Scale bar: 5 mm.

Diagnosis

Tergum with broadly rounded, well-defined spur; scutum with protruding articular ridge extending half length of tergal margin; cirrus VI with four pairs of setae on anterior edge of intermediate segments.

Description

Holotype (MNHN-Ci 2685): rostro-carinal diameter 12.4 mm; width 9.1 mm; height 8.7 mm. Paratype (MNHN-Ci 2686): rostro-carinal diameter 11.4 mm; width 9.7 mm; height 12.5 mm.

Shell white, porcellanous; base calcareous, very thin centrally, but thickened nearer paries, with short but weak terminal ribs or extensions; carina well developed, semi-conic, with extended alae, approximately twice height of rostrum. RL and CL clearly separated from paries of rostrum and carina respectively by broad exposed alar areas on latter plates; internally, RL not entering the sheath. Primary plates transversely sculptured with fine growth lines, each paries with central, very weakly-developed longitudinal ribs, rib spacing approximating apices of basal imbricating

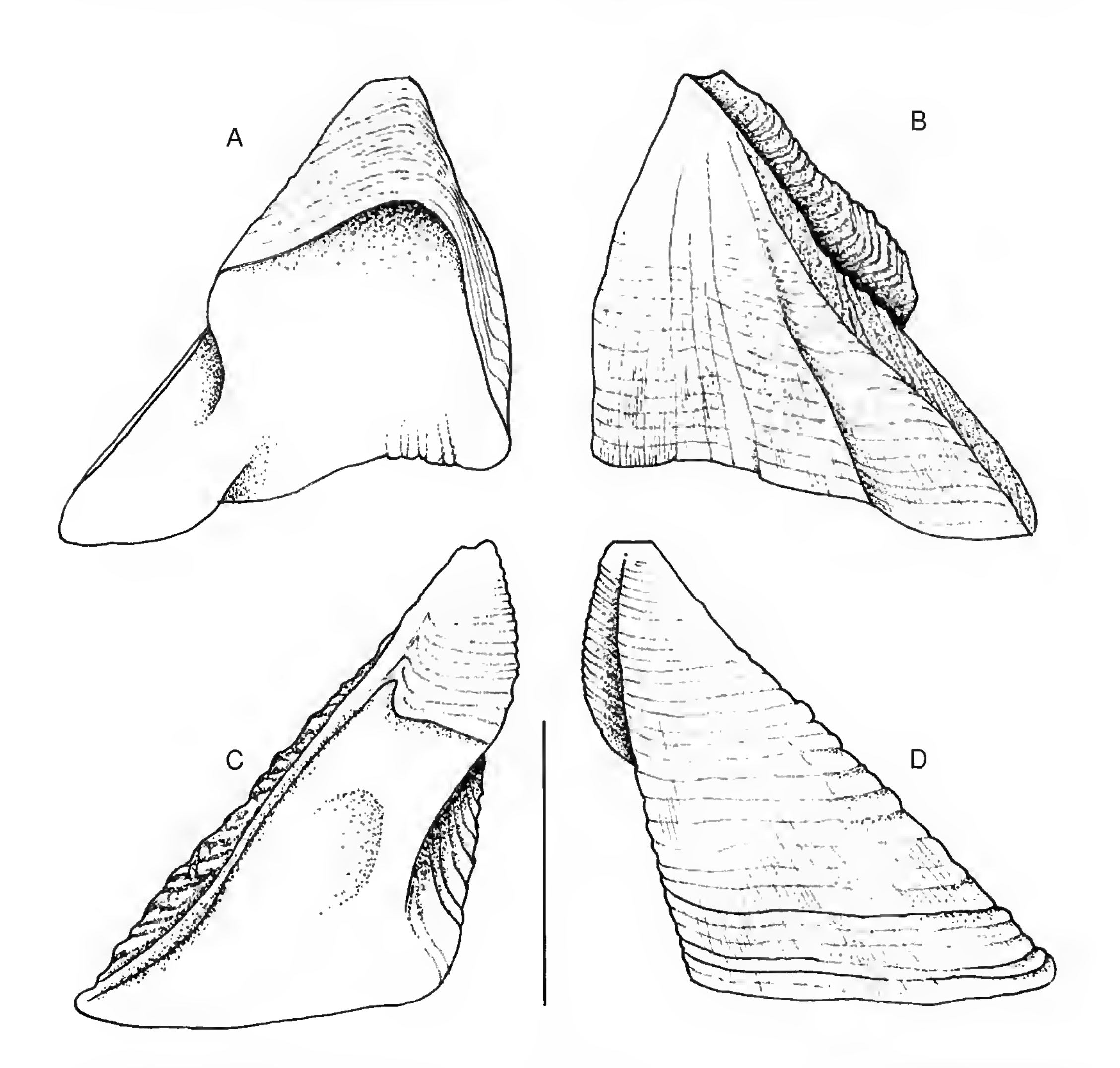


Fig. 2. — *Chionelasmus crosnieri* n.sp., paratype, MNHN-Ci 2686; **A**, tergum (right), interior; **B**, same, exterior; **C**, scutum (right), interior; **D**, same, exterior. Scale bar: 4 mm.

plates; growth lines slightly basally deflected approaching parietal ribs. Alae almost confluent with paries, possessing very fine apico-basal striae transversely between well spaced growth lines, welting absent. Interior of carina with low, narrow rib along alar margin. Imbricating plates trimorphic, two types have "alar extensions" or overlapping margins (either on one, or both sides), one type lacks alar extensions; alar extensions with well formed, subvertical, growth lines; imbricating plates and base of parietal plates in contact with substrate; base of paries slightly inflected inwards.

Opercula (Fig. 2): tergum triangular, basal mar-

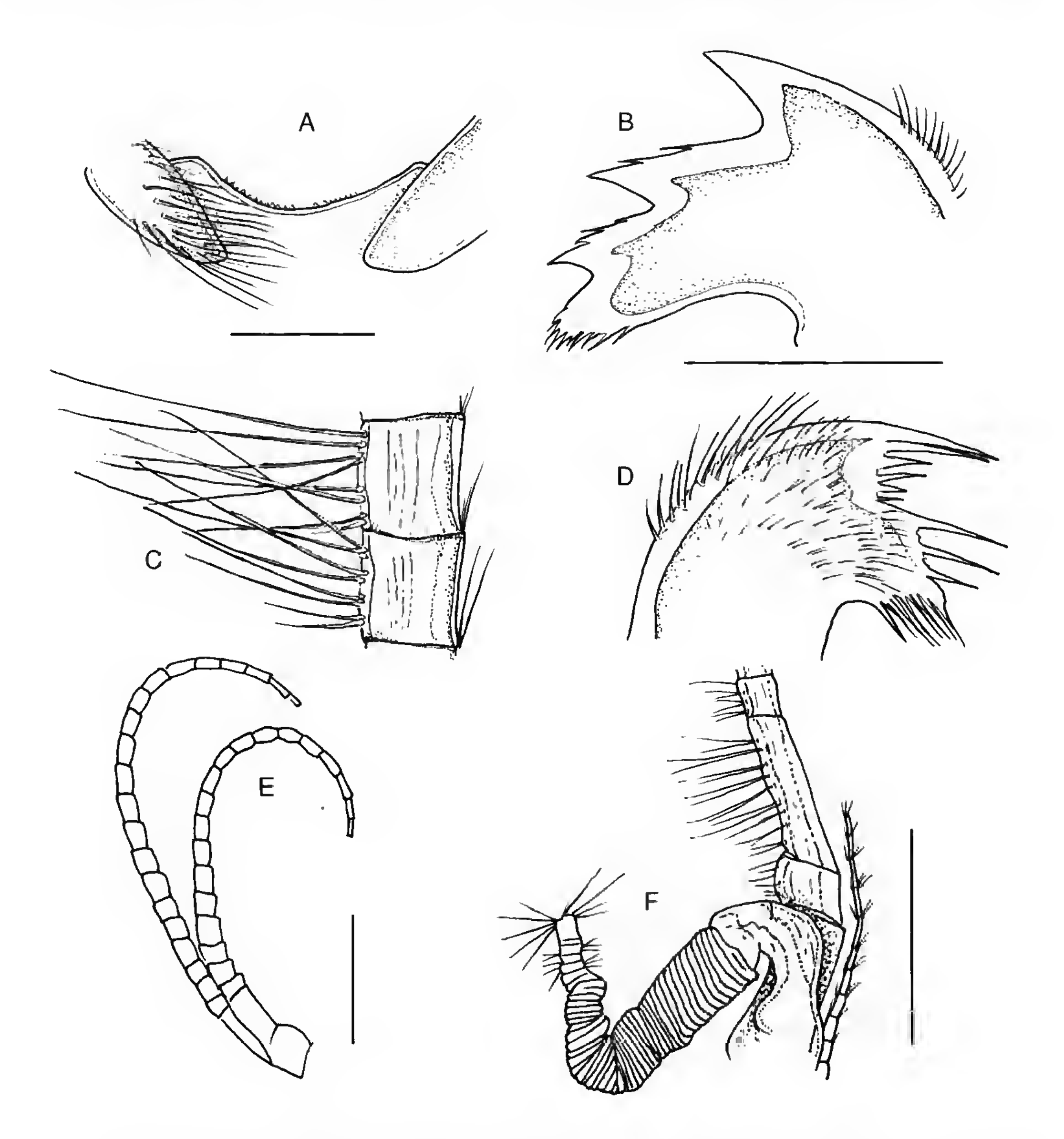


FIG. 3. — *Chionelasmus crosnieri* n.sp., holotype, MNHN-Ci 2685; **A**, labrum and palps (setae shown on left palp only); **B**, mandible (right side); **C**, intermediate segment of cirrus VI showing setal arrangement (right side); **D**, first maxilla (left side); **E**, cirrus III (left side, shown with setae removed); **F**, caudal appendage, penis and basal portion of cirrus VI. Scale bars: A-D, 0.5 mm; E, F, 2 mm.

gin slightly concave, carinal margin slightly convex; exterior with well-developed transverse growth lines crossing strong apico-basal striae, and fine, delicate, apico-basal micro-striae; apico-basal furrow projected as broad, moderately rounded spur at basi-scutal angle; interior with elevated articular ridge; articular furrow moderately deep; crests for depressor muscles moderately developed near basi-carinal angle. Scutum triangular, basal and tergal margins broadly and gently convex; externally with strong growth lines cut by fine apico-basal micro-striae; protruding articular ridge extending half length of tergal margin; internally with weakly-developed, centrally placed, adductor muscle pit; articular ridge elevated with strong transverse growth lines.

Body parts (Fig 3): mandible tridentate, outer edges of second and third teeth with occasional, fine, flattened serrations, inner angle pectinate with numerous short spines; first maxilla with two large upper spines, notch poorly-developed, centrally with group of three large spines, lower angle with numerous smaller spines, relatively hirsute overall; second maxilla bilobed. Penis long, basal third smooth, non-hirsute, outer two thirds annulated, hirsute at end; labrum broadly curved, with numerous small, but well-formed, centrally disposed teeth; palps moderately sharply rounded, with setae primarily on inner side, well-separated.

Cirrus I anterior and posterior rami about equal number of segments. Cirrus II more like cirrus III than cirrus I. Anterior rami of cirri III, VI, V and VI slightly shorter in length than posterior rami, although occasionally with more segments. Cirrus VI with intermediate segments having four pairs of setae on the anterior edge; caudal appendages about twice length of basal pedicel of cirrus VI. For holotype, segments per rami, (first line from cirri on right side, anterior ramus first), and for caudal appendages (c.a.) as follows:

I	II	III	IV	V	VI	c.a.
9/10	15/17	20/21	26/28	27/26	25/28	11
10/10	15/18	21/21	26/23	25/26	23/25	12

Colour (in alcohol): the holotype and paratype shells are presently creamy-white internally and externally. Some soft tissue in the holotype has a straw tinting, *e.g.* the chitinous cutting edges of the mouth parts.

Remarks

This species is unusual in the choice of an octocoral for its host. Specimens from station CH05 are deeply embedded in the coral, with soft tissue covering all but the orifice and opercula (Fig. 5). Yamaguchi (1998) places much emphasis on the disposition, and the number of imbricating plates (see Fig. 4). The number of imbricating plates in *C. crosnieri* varies ontogenetically, and in some specimens may differ slightly on each side of the shell [*e.g.* the larger specimen from CP 2688 (R-C diameter: 9.1 mm) has an extra plate "c^3" on the left side].

The fine, basal ribbing (or nodes) on the parietal plates was initially thought to have been a function of the substrate surface pattern. The specimens grow however, on a cylindrical structure, with a longitudinal surface texture. As such, the ribbing could be expected to be linearly arranged. That they are radial in overall disposition indicates that ribbing is a primary feature.

It is unfortunate that the material described by Foster (1981), from the Kermadec Islands, has been lost from New Zealand's oceanographic collections (held at the National Institute of Water

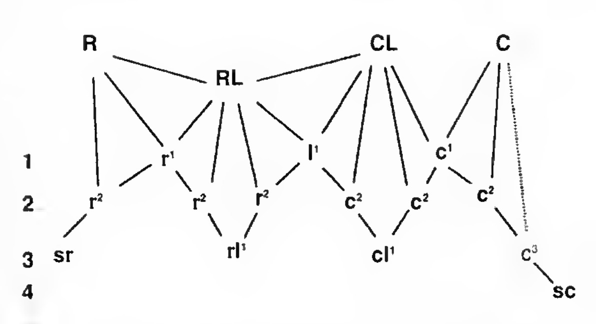


Fig. 4. — *Chionelasmus crosnieri* n.sp. The arrangement of wall plates in adult specimen. Parietal plates: **R**, rostrum; **C**, carina; **RL**, rostrolatus, **CL**, carinolatus. Basal imbricating plates: **r^1**, imbricating plate added between R and l^1; **c^1**, imbricating plate added between l^1 and C; **r^2**, **c^2**, imbricating plates of second tier, variously disposed as shown; **sr** and **sc**, imbricating plates added directly below R and C; **rl^1** and **cl^1** imbricating plates added directly below RL and CL; **c^3** (not in bold), imbricating plate occasionally found below c^2 and C. Numerals down left hand side indicate "whorl number" of imbricating plates. If c^3 present, sc would fall into a fourth whorl.

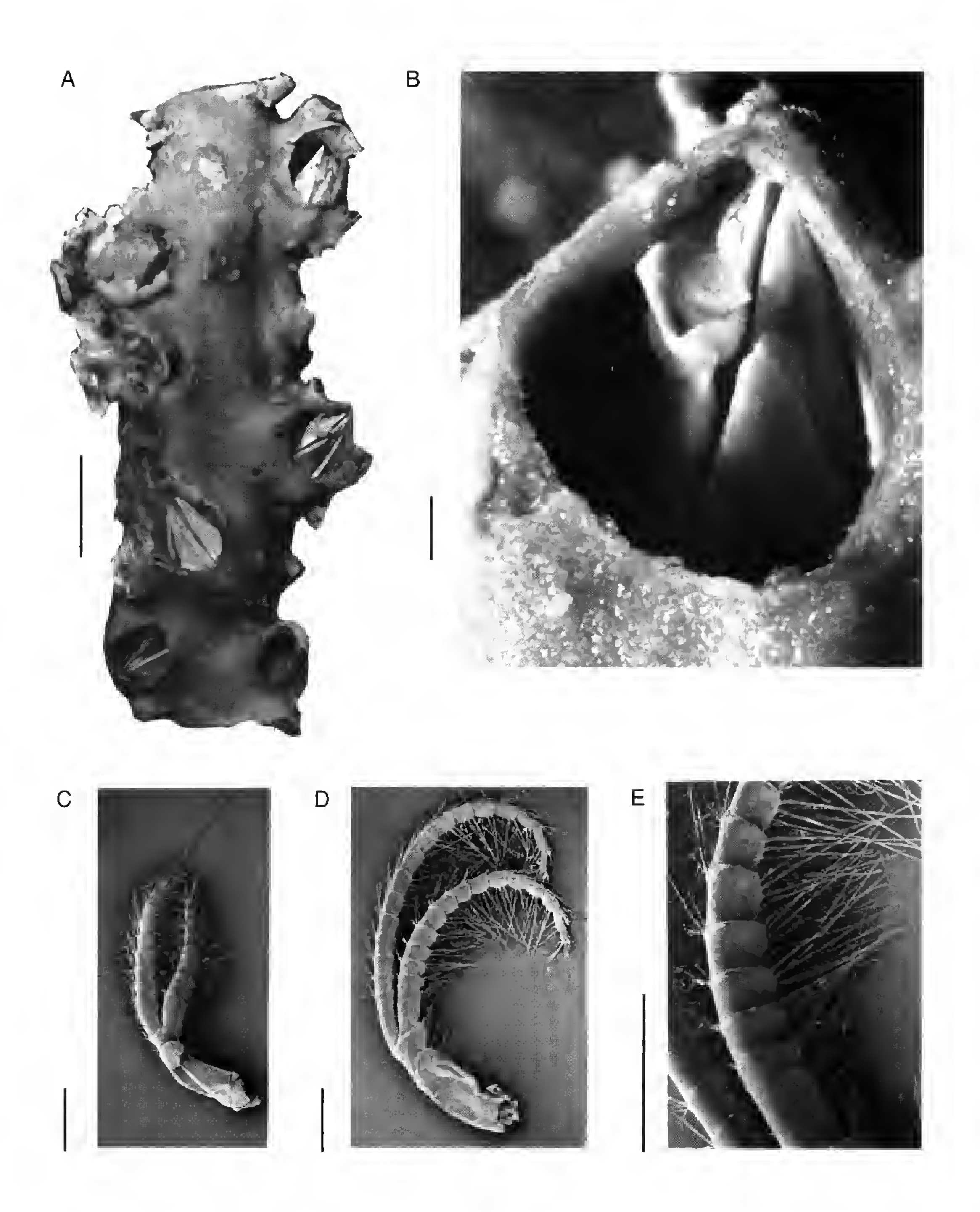


FIG. 5. — *Chionelasmus crosnieri* n.sp.; **A**, the relationship of *C. crosnieri* n.sp. with the host octocoral, *Muricides* sp. indet. (Paratype, MNHN-Ci 2687); **B**, detail of specimen central right of A, showing attached juvenile (damaged); most of the shell, apart from that closest to the orifice is buried within the coral tissue; **C**, cirrus I (left side, SEM photograph); **D**, cirrus II (left side, SEM photograph); **E**, detail of D, showing basal portion of anterior ramus of cirrus II (SEM photograph). Scale bars: A, 10 mm; B-E, 1 mm.

and Atmospheric Research, Wellington). Although Foster did not publish figures of body parts and opercula, he did prepare working diagrams, and these have been made available by courtesy of Professor T. Yamaguchi. The mandible, first maxilla, caudal appendages and penis conform to the holotype of *C. crosnieri* n.sp., but there are no known figures of the labrum or palps. There are slight variations with the opercula, but these differences are interpreted as ontogenetic, Foster's material being juvenile. Nonetheless, the tergum of Foster's material possessed a concave basal margin, and the scutum had an articular ridge that extended for about half the length of the articular margin. These characters, supported by the geographic location of the specimen, are considered sufficient to place the Kermadec Islands material within *C. crosnieri* n.sp.

Specimen MNHN-Ci 2685 (Fig. 1) possesses a small barnacle, attached near the apex of the right tergum (R-C diameter: 2.3 mm). This grew initially within the articular furrow, but with ontogeny, now occupies a larger area on the tergum. Both terga and scuta of this barnacle possess dimpled apical primordial valves. Only the first of the imbricating plates (C^1) is present, with the primary wall of the shell being comprised of six parietal plates (*i.e.* R-RL-CL-C-CL-RL). This arrangement corresponds to that of an early postlarval stage (Newman 1987: fig. 6B), rather than that of a complemental male (as *in* Hui & Moyse 1984).

Host relationships

Chionelasmus crosnieri n.sp. is commensal on an octocoral, *Muricides* sp. indet. It is not attached to the surface of the octocoral however, but to the axial skeleton. Except for the opercula and the apical parts of the carina and rostrum, no part of the barnacle shell is visible, *i.e.* it lies buried within the soft tissue of the coral (Fig. 5). The mechanism by which cyprid larvae gain access to the axial skeleton is unknown, as it is uncertain whether they could burrow through coral tissue. Observations, however, have been made on barnacle commensals on gorgonians living off La Jolla, California (Gomez 1973). Gomez proposed that cyprid larvae of *Balanus galeatus* gained access to the axial skeleton after nudibranch feeding exposed the axis. The barnacles were generally found terminally on coral branches, the preferred sites for nudibranch predation, suggesting that the cyprids attached themselves to the axis during, or shortly after, nudibranch feeding. A similar mechanism may provide an opportunity for *C. crosnieri* cyprids to gain access to the axis of *Muricides*.

Affinities

Chionelasmus crosnieri n.sp. closely resembles *Chionelasmus darwini* (Pilsbry), but may be distinguished from that species by the opercula and body parts. The tergum in *C. crosnieri* n.sp. has a more obtuse apical angle, a broader, more clearly defined spur with a less acute basal angle; the scutum is broader, with the protruding articular ridge extending for about half the length of the tergal margin, it has a basal margin that is broadly convex (rather than concave or sinuous), and a moderately acutely rounded basi-occludent angle. Cirrus VI has four pairs of setae on the anterior edge of intermediate segments (*C. darwini* has five). The mandible lacks the medium-sized secondary teeth that occur in *C. darwini*, and the first maxilla possesses only two upper spines, with numerous fine setae below the lower angle. The penis is only annulated over two thirds of its length, and is only hirsute at the tip (*C. darwini* is annulated and hirsute over the entire length).

This species is similar to specimens of Eocene age from the Chatham Islands, figured in Buckeridge (1983: 61), as *Chionelasmus darwini*. Unfortunately very few opercula have been recovered from the fossil material. Of particular note is the tergal margin of the scutum, which has the protruding tergal ridge extending for about two thirds of its length. This character serves to distinguish the fossil material from all living forms, and places it closest to *C. crosnieri* n.sp. It is hoped that further collecting will clarify the systematic location of the Chatham Islands material, although at present, it seems most likely that it will be placed within *C. crosnieri* as a further subspecies.

C. crosnieri is readily distinguished from *Eochionelasmus ohtai* Yamaguchi, 1990, by

having less than five whorls of imbricating plates, a scutum which possesses an almost 90° basi-tergal angle (*E. ohtai* is broadly rounded) and a tergum, which in *E. ohtai* has a more deeply excavated basal margin. The mouth parts of *E. ohtai*, unlike *C. crosnieri*, possess distinctive features that are interpreted by Yamaguchi & Newman (1990) as adaptations for living in a hydrothermal environment.

BIOGEOGRAPHY

The Southwest Pacific has been interpreted by Buckeridge (1996a), as a centre of Sessilian evolution during the early Cainozoic. Many primitive sessilian cirripedes are first recorded from this part of the world, e.g. *Chionelasmus* is first known from the Eocene of the Chatham Islands [it is also known from the Eocene of Tonga, although detail of this location is unpublished (Yamaguchi & Newman 1990)]. If the Southwest Pacific is confirmed as the centre for chionelasmatoid speciation, this speciation occurred after the breakup of Gondwana. If this is so, long range dispersal during the mid-Cainozoic, rather than vicariance, is the most likely mechanism for *Chionelasmus* to have colonized the Indian Ocean and northern Pacific.

Acknowledgements

The author wishes to sincerely thank Dr. Crosnier for the invitation to work on the MUSORSTOM collections, and for access to the material. Professor William A. Newman, Scripps Institute of Oceanography, La Jolla, CA, and Professor Toshiyuki Yamaguchi, Chiba University, Japan, provided thoughtful comments, via e.mail during the preparation of the manuscript. Mme Marie-José D'Hondt identified the octocoral, and Dr Danielle Defaye (both of Muséum national d'Histoire naturelle, Paris) provided station site data and helpful comments.

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Addendum

One of the referees of this manuscript, Diana S. Jones, has advised that she has a paper in press with the MUSORSTOM series entitled "Cirripedia Thoracica: New Species of Chionelasmtoidea and Pachylasmatoidea (Balanomorpha) of New Caledonia, Vanuatu and Wallis and Futuna Islands, with a review of all currently assigned taxa". This paper includes reference to *Chionelasmus darwini* Nilsson Cantell from the Southwest Pacific, but does not split the species. In light of this work, Jones'paper and Yamaguchi (1998), an opportunity exists for further analysis of the genus as a whole.

Systematic status and geographic distribution of *Trapezia formosa* Smith, 1869 (Crustacea, Brachyura, Trapeziidae), a symbiont of reef corals

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Castro P. 1998. — Systematic status and geographic distribution of *Trapezia formosa* Smith, 1869 (Crustacea, Brachyura, Trapeziidae), a symbiont of reef corals. *Zoosystema* 20 (2) : 177-181.

KEY WORDS
Brachyura,
Trapeziidae,
biogeography,
Pacific ocean.

ABSTRACT
A revision of *Trapezia formosa* Smith, 1869 has shown that it is found throughout the Indo-West Pacific region and not restricted to the eastern Pacific.

MOTS CLÉS
Brachyura,
Trapeziidae,
biogéographie,
océan Pacifique.

RÉSUMÉ
Position systématique et distribution géographique de Trapezia formosa *Smith, 1869 (Crustacea, Brachyura, Trapeziidae), un symbionte des coraux récifaux.* Une révision de *Trapezia formosa* démontre que cette espèce n'est pas limitée au Pacifique oriental mais présente une vaste répartition dans l'Indo-Ouest-Pacifique.

INTRODUCTION

Trapezia formosa, an obligate symbiont of pocilloporid reef corals, is one of four species of the genus that occur in the eastern Pacific region (Fig. 1). It was described from the Gulf of Panama (Smith 1869) and known from the southern Gulf of California in Mexico to northern Ecuador and the Galápagos Islands (Castro 1982, 1996). Castro (1982; 1996) suggested that several Indo-West Pacific records of *T. formosa* had resulted from erroneous identifications and that this species, like *T. corallina* Gerstaecker, 1857, was endemic to the eastern Pacific. Live specimens and museum collections were studied to resolve the taxonomic status of the species and to elucidate its geographic distribution. Holdings of the following institutions were the source of materials:

ASIZ	Academia Sinica, Taipei, Taiwan;
SMF	Forschungsinstitut Senckenberg, Frankfurt;
MNHN	Muséum national d'Histoire naturelle, Paris;
RMNH	Nationaal Natuurhistorisch Museum, Leiden;
BMNH	Natural History Museum, London;
LACM	Natural History Museum of Los Angeles County;
CBM	Natural History Museum and Institute, Chiba, Japan;
SAM	South African Museum, Cape Town;
CHCD	Taiwan Museum, Taipei;
USNM	U.S. National Natural History Museum, Washington;
ZRC	Zoology Reference Collection, National University of Singapore.

TAXONOMY AND GEOGRAPHIC DISTRIBUTION

Trapezia formosa Smith, 1869

Trapezia formosa Smith, 1869: 286 (Panama). – Castro 1996: 544, fig. 4 (synonymy and references for eastern Pacific populations). – Garth 1971: 188 (Maldive Islands). – Ribes 1978: 14 (La Réunion). – Dai *et al.* 1983: 252, 261, fig. 14C, pl. 4, fig. 8 (South China Sea). – Huber 1985: 23 (Marshall Islands). – Chang *et al.* 1987: 215 (Taiwan). – Dai & Yang 1991: 380, 387, fig. 187 (3), pl. 52, fig. 4 (South China Sea). – Castro 1997a: 81 (Coral Sea).

Trapezia digitalis var. *formosa* – Borradaile 1902: 265 (Maldive Islands).

Trapezia ferruginea – Tweedie 1950: 126 (Cocos (Keeling) Islands; part.) (not *Trapezia ferruginea* Latreille, 1828).

Trapezia bella – Serène 1984 : 278, fig. 187, pl. 38, fig. F (La Réunion). (not *Trapezia bella* Dana, 1852) not *Trapezia formosa* : see synonymy for *Trapezia globosa* (Castro 1997b).

MATERIAL EXAMINED. — **Eastern Pacific.** Mexico, Clipperton Island, Costa Rica, Panama, Colombia, Ecuador, Galápagos Islands: see Castro (1996).
Marshall Islands. Enewetak Atoll, stn 197, 1965, coll. J. W. Knudsen: 1 ♂, 3 ♀♀ (LACM). — Stn 196, coll. J. W. Knudsen: 7 ♂♂, 10 ♀♀, 1 juv. (LACM); 5.VIII.1967, coll. J. W. Knudsen: 12 ♂♂, 9 ♀♀ (LACM).
Tuvalu. Onotoa Island, 7 m, 8.X.1951, coll. A. H. Banner: 1 ♂ (USNM).
Coral Sea. Chesterfield Islands, stn DW 92, 19°03.0'S - 158°53.93'E, *Corail 2*, ORSTOM, 8 m, 26.VIII.1988: 4 ♂♂, 4 ♀♀ (MNHN-B 25191).
Japan. Kii, Shionomisaki, on *Pocillopora damicornis*, 10-20 m, 25.V.1995, coll. K. Nomura: 1 ♂ (CBM). — Ryukyu Islands, Yoron Island, 22.VII.1967, coll. T. Sakai: 6 ♂♂, 3 ♀♀ (SMF 23339).
Taiwan. Orchid (Lan-Yu) Island, 26°03'N - 121°32'E, on *P. damicornis*, 6.I.1982, coll. Y.-S. Chen: 1 ♂, 1 ♀ (LACM 82-125.4); 21-22.III.1996: 1 ♀ (CHCD 1054). — Kenting National Park, 26.IV.1986, coll. M.-S. Jeng: 1 ♂, 1 ♀ (ASIZ); 17-20.IV.1996: 1 ♂, 1 ♀ (CHCD).
Guam. Pago Bay, on *Pocillopora meandrina* and *P. verrucosa*: 10-11.IX.1997, coll. P. Castro: 3 ♂♂, 5 ♀♀ (SMF).
Spratly (Nansha) Islands. Taiping Island, 114°22'E - 10°23'N, 20.IV.1994, coll. M.-S. Jeng: 3 ♂♂, 3 ♀♀, 1 juv. (ASIZ).
Indonesia. Ambon, stn 39, Rumphius Biohistorical Expedition, 0.5 m, 8.VII.1990, coll. M. Lavaleye: 1 ♀ (RMNH D 47108). — Stn 27, 26-27.XI.1990: 1 ♂ (RMNH D 47105), 2 ♀♀ (RMNH D 47106).
Cocos (Keeling) Islands. 1941, coll. C. A. Gibson-Hill: 1 ♂, 2 ♀♀ (ZRC 1997.777).
Kenya. Mombasa, Ras Iwatine, 4°01.3'S - 39°44'E, on *Stylophora*, 1 m, 27.II.1971, coll. A. J. Bruce: 1 ♂, 1 ♀ (BMNH). — Mombasa Island, 4°04.5'S - 39°40.5'E, coll. A. J. Bruce: 1 ♂ (BMNH). — Tiwi, 4°15'S - 38°36'E, 2 m, 1.III.1971, coll. A. J. Bruce: 1 ♀ (BMNH); 14.III.1972, coll. N. Bruce: 1 ♂ (MNHN-B 25292).
Seychelles. Aride Island, stn 711, 4°13'S - 55°40'E, NIOP-E *Tyro* Seychelles Expedition, on *P. verrucosa*, 19.XII.1992: 1 ♂ (RMNH D 47109). — Praslin Island, on small *Pocillopora*, 17.II.1972, coll. A. J. Bruce: 5 ♂♂, 6 ♀♀ (MNHN-B 25289). —

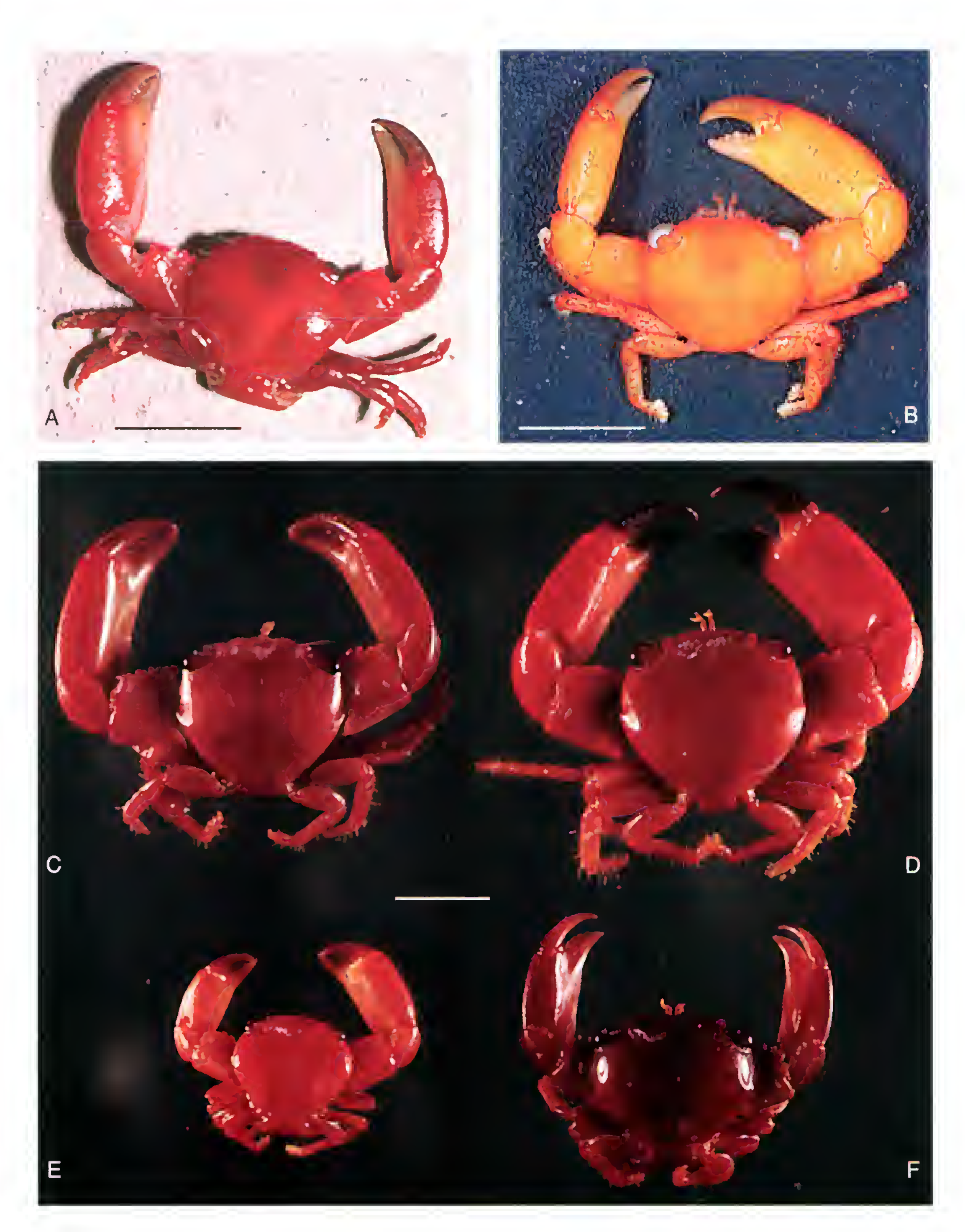


Fig. 1. — **A**, *Trapezia formosa* Smith, 1869: live specimen from Enewetak, Marshall Islands (photograph courtesy of M. Huber); **B**, *Trapezia formosa* Smith, 1869: live specimen from Arid Island, Seychelles (RMNH D 47109). **C-E**, Eastern Pacific species of *Trapezia* (preserved specimens from Gorgona Island, Colombia): **C**, *T. corallina* Gerstaecker, 1857 (top right); **D**, *T. ferruginea* Latreille, 1828 (top left); **E**, *T. formosa* Smith, 1869 (lower right); **F**, *T. digitalis* Latreille, 1828 (lower left). Scale bars: 1 cm.

Stn 27, 4°58'N - 54°59'E, *Reves 2*, ORSTOM, 25 m, 8.IX.1980: 1 ♂ (MNHN-B 25290). — Mahé Island, stn 612, 4°65'S - 55°31'E, NIOP-E *Tyro* Seychelles Expedition, reef flat and slope, on *P. verrucosa*, 12.XII.1992: 2 ♂ (RMNH D 47110). — Remire Reef, 12.II.1972, coll. A. J. Bruce: 1 ♂, 1 ♀ (MNHN-B 25288). — St François Atoll, stn 792, 7°05'S - 52°44'E, NIOP-E *Tyro* Seychelles Expedition, on *P. eydouxi*, outer slope, 5-6.I.1993: 1 ♂, 1 ♀ (RMNH D 47107); 1 ♂ (RMNH D 47111).
Aldabra Island. 1 ♂, 1 ♀ (MNHN-B 14034).
Îles Glorieuses. 16.IX.1958, coll. A. Crosnier & J. Millot: 2 ♂♂, 1 ♀ (MNHN-B 25291).
La Réunion. La Saline, on *P. verrucosa*, outer reef slope, 5 m, coll. S. Ribes: 1 ♂, 1 ♀ (MNHN-B 8345); on *Stylophora*, outer reef slope, 5 m, coll. S. Ribes: 3 ♂♂, 2 ♀♀ (MNHN-B 23096); on *P. verrucosa*, coll. S. Ribes: 1 ♂, 1 ♀ (MNHN-B 23097); on *P. verrucosa*, outer reef slope, 15 m, coll. S. Ribes: 2 ♂♂, 2 ♀♀ (MNHN-B 23098). — St Gilles, reef flat, 17.IX.1982, coll. M. de St Laurent: 1 ♀ (MHNR 26).
Mozambique. Coconut Bay, 17.V.1973, coll. B. Kensley: 1 ♀ (SAM A43242).

DISCUSSION

Trapezia formosa, together with five other species (*T. bella* Dana, 1852, *T. cheni* Galil, 1983, *T. garthi* Galil, 1983, *T. globosa* Castro, 1997 and *T. speciosa* Dana, 1852), is characterized by its small size, relatively thick chelipeds with short and stubby fingers, carapace with rounded antero-lateral borders, reduced or absent epibranchial teeth and the absence, except in juveniles, of a suture between the second and third thoracic sternites. The six species are best differentiated by their colour patterns (see Castro 1997b). *T. formosa* is most common in small colonies and live coral fragments.

There are no morphological differences between Indo-West Pacific and eastern Pacific populations of *T. formosa*. Apparent differences in the morphology of the male gonopod were found to be a function of size. It becomes rounder with increasing size in all populations studied.

Slight colour differences, nevertheless, distinguish eastern Pacific populations from Indo-West Pacific ones. Examination of live individuals from Guam, freshly-preserved ones from Okinawa and colour photographs of live individuals from Taiwan (Fig. 2A, B), the Marshall Islands (Fig. 1A) and the Seychelles (Fig. 1B) shows that the carapace and chelipeds are bright

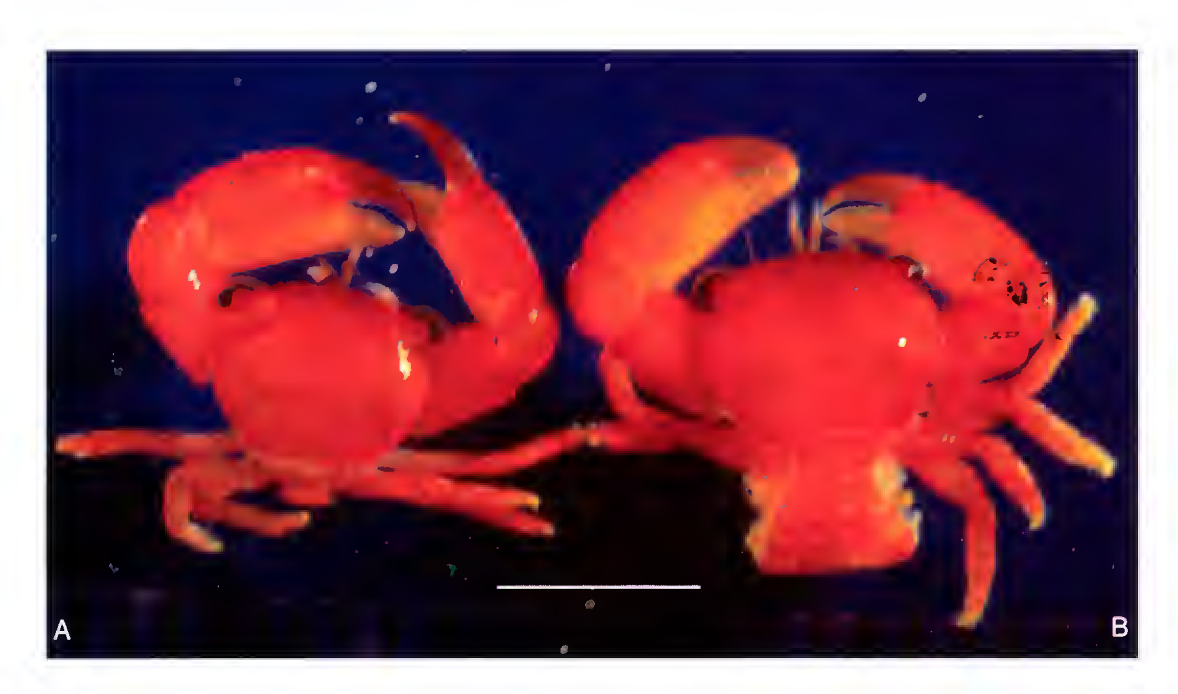


FIG. 2. — **A**, **B**, *Trapezia formosa* Smith, 1869: live specimens from Orchid Island, Taiwan (LACM 82-125.4). Scale bars: 1 cm.

orange throughout the range of the species. The walking legs of Indo-West Pacific individuals, however, show fine, net-like red lines, a character never reported from live eastern Pacific specimens (Castro 1996). Color photographs of live specimens from Panama and close observation of preserved specimens from this and other eastern Pacific locations revealed a similar, though not equally noticeable pattern. Another difference is that, with the exception of eastern Pacific and Guam individuals, the anterolateral and anterior borders of the carapace and anterior and distal borders of the cheliped merus and carpus are orange red. The colour of preserved specimens from the South China Sea was given as "orange red" with dark "net-like markings" on the dorsal surface of the appendages (Dai *et al.* 1983) and orange "outlined by dark orange lines" with an "obscure meshwork pattern" on the appendages (Dai & Yang 1991).

Throughout its range, *T. formosa* shows square to irregular orange red to dark brown reticulations that cover the upper half of the inner border of the cheliped propodus. The lower half is orange yellow; the fingers brown. The eyes are greenish grey.

In spite of similarities in morphology and colour pattern, the genetic distance between Panama and Enewetak populations of *T. formosa* were found to be similar to genetic distance between morphologically close but distinct species of *Trapezia* (see Huber 1985). Little or no gene flow appears to take place between the Panama and Enewetak populations. Further studies of gene-enzyme systems and DNA may ultimately provide evidence to show that geographically isolated populations of *T. formosa* and other widely distributed species of trapeziids such as *T. ferruginea* Latreille, 1828 and *T. digitalis* Latreille, 1828 are genetically isolated species. These species could perhaps be distinguished by small differences in colour patterns, not by morphological characters used in traditional taxonomy.

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Special thanks are due to A. Crosnier for entrusting me with ORSTOM's collections and for driving me into new territories, which launched this and other investigations.

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A new reef lobster of the genus *Enoplometopus* A. Milne Edwards, 1862 (Decapoda, Nephropoidea) from the western and southern Pacific

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Chan T.-Y. & Yu H.-P. 1998. — A new reef lobster of the genus *Enoplometopus* A. Milne Edwards, 1862 (Decapoda, Nephropoidea) from the western and southern Pacific. *Zoosystema* 20 (2): 183-192.

ABSTRACT
A new reef lobster, *Enoplometopus crosnieri* n.sp., is described based on a Taiwanese specimen. This new species can be readily distinguished from all others of the genus by having one intermediate and one postcervical teeth on the carapace, as well as a distinctive coloration. *E. crosnieri* is also known from the Timor Sea and French Polynesia. A key to the genus *Enoplometopus* is also provided.

KEY WORDS
Crustacea,
Decapoda,
Nephropoidea,
Enoplometopus,
new species.

RÉSUMÉ
Une nouvelle langouste récifale du genre Enoplometopus *A. Milne Edwards, 1862 (Decapoda, Nephropoidea) de l'ouest et du sud Pacifique.* Une nouvelle « langousre » récifale, *Enoplometopus crosnieri* n.sp., est décrite à partir d'un spécimen de Taïwan. Cette nouvelle espèce peut être facilement distinguée de toutes les autres du genre par la présence sur la carapace d'une dent intermédiaire et d'une dent postcervicale et par sa coloration distincte. *E. crosnieri* est également signalée de la mer de Timor et de Polynésie française. Une clé du genre *Enoplometopus* est présentée.

MOTS CLÉS
Crustacea,
Decapoda,
Nephropoidea,
Enoplometopus,
nouvelle espèce.

INTRODUCTION

In January 1997, a live specimen of an unusual reef lobster of the genus *Enoplometopus* A. Milne-Edwards, 1862, was found in a sea-food restaurant near the National Taiwan Ocean University (NTOU), Keelung. The animal was immediately purchased and kept in an aquarium at the NTOU. This large specimen was found to have a completely different coloration (Figs 1, 2) than *E. occidentalis* (Randall, 1840), the only species of the genus previously known from Taiwan (Chan & Yu 1993). Although the presence of a large red ocellus (or "bullseye") on the lateral carapace in our Taiwanese specimen resembles the colour pattern reported for *E. holthuisi* Gordon, 1968, the morphological characters of the Taiwanese specimen differ considerably from *E. holthuisi*. Our specimen and *E. holthuisi* could be assigned to different subgenera or even genera [e.g. *Enoplometopus* (*sensu* Holthuis 1983) for the Taiwanese specimen and *Hoplometopus* Holthuis, 1983 for *E. holthuisi*] according to some authors (*e.g.* Holthuis 1983; Kensley & Child 1986; de Saint Laurent 1988; Türkay 1989; Poupin *et al.* 1990; Poupin 1996). Careful comparisons showed that our specimen is distinct from all known species of the genus. Moreover, the colour photograph of a specimen from French Polynesia (Poupin *et al.* 1990: pl. III-c; Poupin 1996: pl. V-h), and some unpublished photographs of a specimen from the Timor Sea (A. J. Bruce, pers. comm.) also clearly show that they represent the same undescribed species discovered in Taiwan. This reef lobster is here described.

MATERIAL AND METHODS

The Taiwanese specimen was kept in an aquarium at NTOU for about four months, molting once before dying. Both the specimen and complete molt are deposited at the crustacean collection at NTOU. The carapace length (cl) and body length (bl) given were measured dorsally from the orbital margin to the posterior margin of the carapace and distal margin of the telson, respectively.

The following species deposited at NTOU were used for comparisons: *E. occidentalis* (Randall, 1840) [Taiwan: 3 ♂♂ 44.2-46.5 mm cl; 4 ♀♀ 31.9-44.8 mm cl; Singapore aquarium shops, place of origin unknown: 1 ♀ 14.3 mm cl], *E. debelius* Holthuis, 1983 [Singapore aquarium shops, place of origin unknown: 2 ♂♂ 11.2-13.8 mm cl, 1 ♀ 12.3 mm cl], *E. daumi* Holthuis, 1983 [Philippines, 1 ovig. ♀ 18.5 mm cl; Singapore aquarium shops, place of origin unknown: 3 ♂♂ 13.6-18.6mm cl, 2 ♀♀ 13.1-14.2 mm cl], *E. gracilipes* (de Saint Laurent, 1988) [French Polynesia: 1 ♂ 46.1 mm cl].

SYSTEMATIC ACCOUNT

Enoplometopus crosnieri n.sp.
(Figs 1-3)

Enoplometopus n.sp. – Poupin *et al.* 1990: pl. III-c; Poupin 1996: pl. V-h.

MATERIAL EXAMINED. — **Northern Taiwan.** Keelung, Ho-Ping Island (probably caught with lobster trap net at about 100 m deep off Keelung), January 1997: holotype, ovig. ♀, 55.4 mm cl, 135.7 mm tl, molt 54.7 mm cl, obtained from sea-food restaurant in fish market (NTOU 1997-1-H).

TYPE-LOCALITY. — Keelung, northern Taiwan.

ETYMOLOGY. — The genus *Enoplometopus* already has species named after two prominent macruran decapod taxonomists who are still with us; *i.e.* F. A. Chace Jr. and L. B. Holthuis. It is a pleasure here to include A. Crosnier's name in this genus. Moreover, this active and colourful lobster matches well with the impression of A. Crosnier to other carcinology colleagues.

SIZE. — Rather large for the genus, with carapace length 46-54.7 mm.

DISTRIBUTION. — Western and southern Pacific; known with certainty from Taiwan, Timor Sea (near Darwin, Australia) and French Polynesia (see "Remarks"). At depths of about 100 m, on hard bottoms.

DESCRIPTION

Size moderately large. Body distinctly pubescent and with many long stiff hairs. Rostrum elongated, triangular and sharply pointed; exceeding antennular peduncle, and armed with two pairs

of lateral teeth. Carapace bearing one large supra-ocular spine, one large intermediate, six median, two lateral and one postcervical teeth; intermediate tooth larger than supra-ocular spine; median teeth with anteriormost one small but distinct while posteriormost one more or less as large as intermediate tooth; postcervical tooth large, similar in size to supra-ocular spine. Anterolateral carapace armed with large antennal spine (strongly bent inwards) and minute branchiostegal spine. Dorsal surfaces of rostrum and carapace scattered with few long stiff hairs. Eyes well-developed, subspherical. Scaphocerite (including distolateral tooth) reaching tip of antennular peduncle. Antennal peduncle slightly overreaching scaphocerite; basal segment bearing a strong ventral spine (basicerite spine), with dorsolateral angle blunt and not developed into spine.

Maxilliped III overreaching scaphocerite by distal two segments; carpus bearing small distoventral spine; merus with two large distoventral teeth; ischium having one disto-outer and one disto-ventral spines, inner margin serrated, consisting of row of sharp teeth; basis with distoventral spine. First chelipeds exceeding scaphocerite by one half carpus; almost equal in size and shape except for cutting edges of fingers; chelae with fingers slightly longer than palm; fixed finger slightly longer than movable finger, outer and inner margins heavily serrated with large teeth and covered with many long stiff hairs, tips of fingers elongate and curving inwards; dorsal and ventral surfaces of palm densely covered with sharp tubercles except for marginal areas; dorsal hinge of fingers armed with large tooth, ventral hinge bearing large tubercle; fingers distinctly ridged medially and bearing only few sharp tubercles near bases; cutting edges of right fingers distributed with many small crushing teeth as well as a few larger ones on that of movable finger, while that of fixed finger also bearing five large broad teeth; cutting edges of left fingers serrated, with numerous small sharp teeth, that of fixed finger also bearing six large teeth while that



FIG. 1. — *Enoplometopus crosnieri* n.sp., holotype ovig. ♀, 55.4 mm cl., Keelung, Taiwan (NTOU 1997-1-H).

of movable finger having eleven additional moderate sized teeth; some long stiff hairs present along cutting edges of both chelae; carpus and merus nearly completely covered with large and small teeth along all margins; ischium having inner margin entirely serrated with teeth, outer margin bearing only large distal tooth. Pereiopods II to V subchelate, with distal prolongations (or palms) of propodi becoming less developed posteriorly; distal prolongation of propodus bearing two long distal spines in pereiopod II, that of pereiopod III having two distal and one subdistoventral long spines, that of pereiopod IV with three distal and one subdistoventral long spines, that of pereiopod V spoon-shaped and without spine; dactylus of pereiopod V also bearing basal knob. Receptaculum seminis on thoracic sternum with blunt anterior end; posterior end wider and also blunt; lateral margins as double convex lobes, without spine or tubercle.

Abdomen with many long stiff hairs (more numerous posteriorly), bearing a low but distinct median ridge on somites II to VI; pleura II, III, IV and VI provided with blunt posterolateral angle; pleuron V with margins generally smooth. Telson trapezoid and slightly longer than maximum width, bearing one pair of movable lateral spines and three pairs of posterolateral spines (inner pair longest). Uropods with protopodite divided dorsally into two lobes each with sharp spine-like apex, inner lobe also bearing two to three spinules on lateral margin and one spine on posterior margin; endopod shorter than telson and armed with a posterolateral spine; exopod slightly longer than telson, having distinct diaeresis with strong outer spine followed by one movable spine.

Coloration

Body generally orange red. Eyes dark brown. Carapace with large white-margined red ocellus (or bullseye) on lateral surface. Two narrow oblique white lines running from dorsal to ventral carapace, also present behind the bullseye. Anterodorsal carapace pinkish and distributed with many red blotches. Teeth on dorsal carapace banded with red and white. Rostral teeth, antennular and antennal peduncles with alternating orange and white bands. Antennular flagella with outer surface orange; inner surface whitish. Antennal flagella uniformly orange. Base of antennal peduncle and branchiostegal area on carapace conspicuously white, with area in-between distinctly reddish. Abdominal tergites mainly orange pink and with some scattered red blotches; dorsal ridges on somite II to VI reddish, each bearing white median spot; red-margined white spot present above each abdominal hinge; pleura generally reddish and bearing two large white spots antero- and posterolaterally (former one larger); somite VI covered with irregular thick transverse white band near posterior margin. Tailfan with distal margin reddish, basal part mostly reddish, and distal part mainly pale purple.

Maxilliped III with alternating orange and white bands. Large cheliped with palm light purplish red, tubercles reddish, teeth on lateral margins whitish and with red bases (those on inner margin of palm as large red spots); hinge between fingers marked as large red spot; fixed finger whitish and with median ridge covered with thick red bands, cutting edges with small reddish teeth and large whitish teeth; movable finger orange purple, with median ridge covered with thick red bands, teeth on outer margin orange and with red bases, cutting edge with small reddish teeth and large teeth somewhat orange; carpus and merus with alternating orange and white bands, disto-dorsal margin of both segments bright purple, teeth generally whitish, with red bases. Pereiopods II to V with distal three segments entirely orange while meri and ischia with alternating orange and white bands, large white spot also present on lateral side of coxae. Pubescence on body light brown, with long stiff hairs golden brown. Eggs dark purple.

Remarks

The present species can be readily separated from all the other known species of the genus and being somewhat intermediate between the two subgenera (or genera) "*Enoplometopus*" (*sensu* Holthuis 1983) and *Hoplometopus* Holthuis, 1983 proposed by some authors (*e.g.* Holthuis 1983; Kensley & Child 1986; de Saint Laurent 1988; Türkay 1989; Poupin *et al.* 1990; Poupin 1996). Morphologically, it may be grouped in



FIG. 2. — *Enoplometopus crosnieri* n.sp., holotype ♀, 55.4 mm cl., Keelung, Taiwan (NTOU 1997-1-H); **A**, lateral view; **B**, dorsal view.

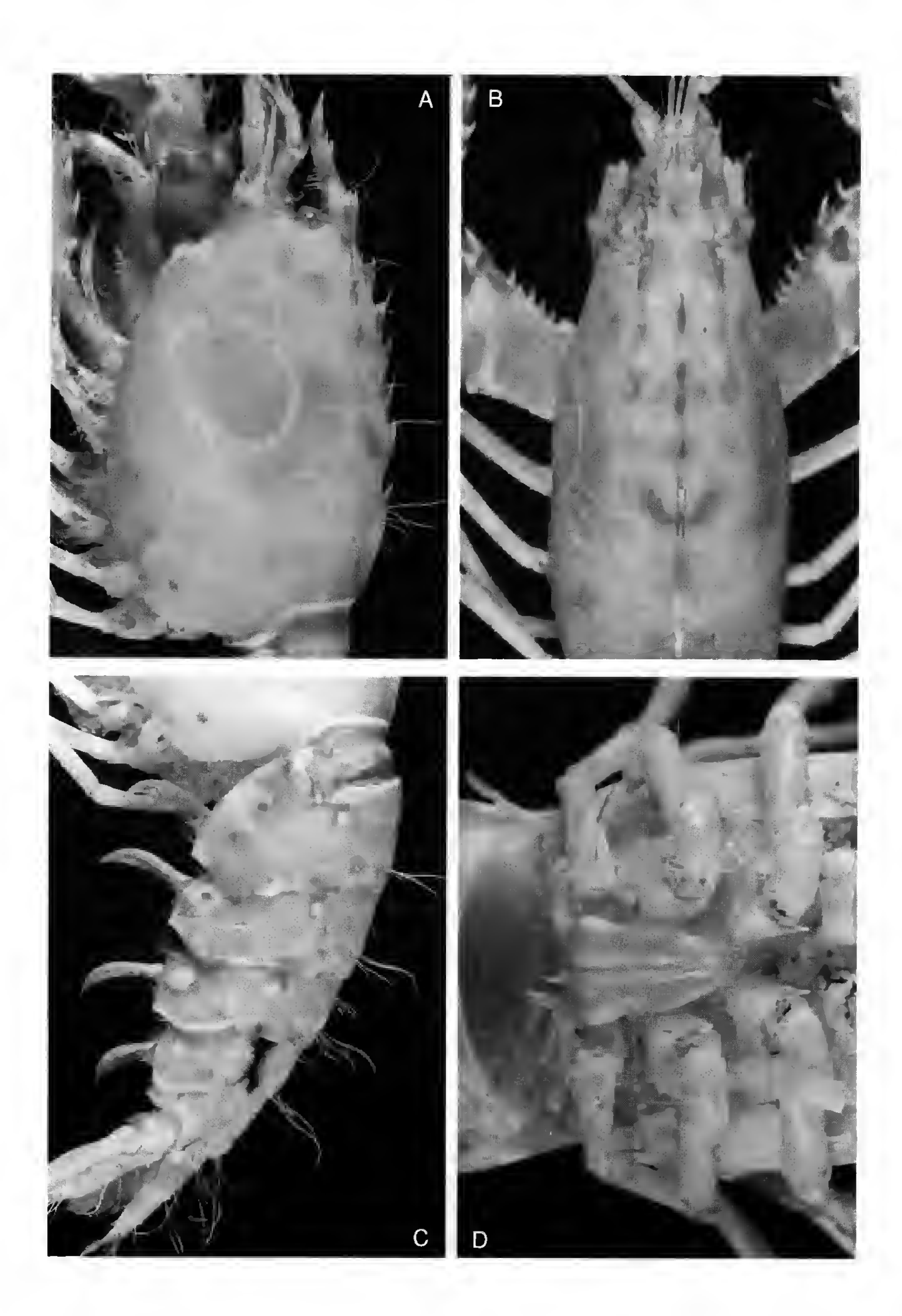


FIG. 3. — *Enoplometopus crosnieri* n.sp., molt of holotype ♀, 54.7 mm cl., Keelung, Taiwan (NTOU 1997-1-H); **A**, carapace, lateral view; **B**, carapace, dorsal view; **C**, abdomen, lateral view; **D**, receptaculum seminis, ventral view.

Holthuis (1983) subgenus "*Enoplometopus*" by bearing one postcervical tooth, abdominal pleura only bluntly angular and the telson armed with one lateral spine. Nevertheless, for the number of intermediate teeth on the carapace (*i.e.* one instead of two) it conforms to the definition of *Hoplometopus*. Moreover, the presence of a large "bullseye" on the lateral carapace is very similar to the colour pattern of *E. antillensis* Lütken, 1865 (see photo *in* Gonzalez 1995) and *E. holthuisi* Gordon, 1968 (see photo *in* Debelius 1986; Debelius & Baensch 1994; Gosliner *et al.* 1996), the latter two species being both grouped in the so-called *Hoplometopus*. Therefore, the present species is treated as new for its unique combination of the above characters.

Compared to the five known species of the so-called "*Enoplometopus*" group (*sensu* Holthuis 1983), the present new species is distinct in having only one intermediate tooth and bearing a bullseye on the lateral carapace. Furthermore, it appears that only *E. occidentalis* (Randall, 1840) of this group can attain to a similar large size as *E. crosnieri*. A comparison of *E. crosnieri* with the four species at hand [i.e. *E. occidentalis*, *E. debelius* Holthuis, 1983, *E. daumi* Holthuis, 1983 and *E. gracilipes* (de Saint Laurent, 1988)] showed that the new species is also distinct in bearing only two pairs of lateral teeth on rostrum, carapace having two lateral teeth but six median teeth, branchiostegal spine very small, large chelipeds and inner protopodite of uropods more spinous, and receptaculum seminis with lateral margins smooth. It is found that the abdomens of *E. occidentalis* and *E. gracilipes* bear a blunt median ridge, too. The median ridge is rudimentary in *E. gracilipes* but it is progressively more developed with size in *E. occidentalis*. On the other hand, no trace of median ridge is observed in *E. debelius* and *E. daumi*. *E. chacei* Kensley *et* Child, 1986 appears also do not possess a median ridge on the abdomen. It is interesting that the postcervical "spine" is merely represented by a small protrusion in the six specimens of *E. daumi* at NTOU (though in live specimens this postcervical protrusion was white in colour and being very distinct). In this way, the character used by Kensley & Child (1986) to separate *E. chacei* from *E. daumi* becomes unclear. Nevertheless, the possession of only two pairs of rostral teeth in *E. chacei* can probably separate it from *E. daumi* as well as the other species of the "*Enoplometopus*" group (*sensu* Holthuis 1983) except *E. crosnieri* (which, on the other hand, differs from *E. chacei* in many other characters as mentioned above). Species of this genus generally have a very distinctive coloration, and their identifications are heavily relied on coloration but with very slight morphological differences perceived (*e.g.* Holthuis 1983; Kensley & Child 1986; Türkay 1989). Nevertheless, it seems that some constant morphological differences can probably be found amongst the species if more specimens are available for direct comparisons. In the meantime, coloration is still a very important character in distinguishing the species of *Enoplometopus* and the following key is proposed for the eleven species recognized at present as valid in this genus.

KEY TO THE SPECIES OF THE GENUS *Enoplometopus*

1. Carapace at most with one postcervical tooth; abdominal pleura broadly convex or with a blunt posterolateral angle; lateral margins of telson armed with one pair of median spines 2

— Carapace with two postcervical teeth; abdominal pleura bearing a strong tooth; lateral margin of telson armed with two pairs of median spines 7

2. Carapace with one intermediate tooth and a very large ocellated spot on lateral surface .... *E. crosnieri* n.sp.

— Carapace with two intermediate teeth and without very large spot on lateral surface 3

3. Rostrum bearing two pairs of lateral teeth; body orange red and with colour markings limited to lower carapace and posterior margins of abdominal somites .... *E. chacei* Kensley *et* Child, 1986

— Rostrum bearing three or more pairs of lateral teeth; colour spots and/or stripes present on entire body 4

4. Five median teeth on carapace 5

— Four median teeth on carapace 6

5. Postcervical tooth large; body orange red and with some conspicuous white spots on abdomen, fewer on carapace, posterior pereiopods with alternating white and orange bands .... *E. occidentalis* (Randall, 1840)

— Postcervical tooth indistinct or absent; body purple red and with blue-margined white spots, posterior pereiopods not banded and posterior margin of tailfan bluish .... *E. pictus* A. Milne Edwards, 1862

6. Postcervical tooth distinct; body whitish and almost uniformly covered with small purple dots .... *E. debelius* Holthuis, 1983

— Postcervical tooth rather indistinct; body purplish with carapace bearing vertical reddish brown stripes and abdomen provided with many white spots .... *E. daumi* Holthuis, 1983

7. Lateral carapace with large ocellated spot 8

— Lateral carapace without large ocellated spot 9

8. Dorsal carapace covered with fine red dots; antennular flagella uniformly reddish .. .. *E. antillensis* Lütken, 1865

— Dorsal carapace distributed with irregular white stripes; antennular flagella with alternating red and white bands .... *E. holthuisi* Gordon, 1967

9. Carapace covered with irregular orange red stripes ...... *E. voigtmanni* Türkay, 1989

— Carapace covered with red spots 10

10. Antennal flagella whitish; antennular flagella with alternating red and white bands; abdominal pleura and tailfan with many conspicuous white spots .... *E. callistus* Intés *et* Le Loeuff, 1970

— Antennal and antennular flagella uniformly orange red; abdominal pleura and tailfan without distinct white spots .... *E. gracilipes* (de Saint Laurent, 1988)

(Only *E. antillensis* and *E. callistus* are found in the Atlantic, all other species inhabit the Indo-West Pacific.)

The presence of a bullseye on the lateral carapace makes the coloration of *E. crosnieri* rather similar to *E. holthuisi* (Debelius 1986; Debelius & Baensch 1994; Gosliner *et al.* 1996; Poupin 1996: pl. VIa-b, as "*Hoplometopus* n.sp.") which is also widely distributed in the western Pacific (perhaps even in the Indo-West Pacific). Other than these two species are morphologically very different, it appears that the bullseye of *E. holthuisi* has a median white spot which is lacking in *E. crosnieri*. Moreover, the antennular flagella as well as the pereiopods II to V are distinctly banded in *E. holthuisi* but in *E. crosnieri* the antennular flagella and the distal three segments of pereiopods II to V are not banded. Further differences in the coloration of *E. holthuisi* from *E. crosnieri* are: branchiostegal area without large white spot, white lines on posterior carapace more numerous and interrupted, large chelipeds without any bright purple colour and hinge of fingers not particularly reddish, and abdomen bearing more white spots. *E. antillensis* from the Atlantic also has a bullseye on the lateral carapace (Gonzalez 1995). Nevertheless, its coloration differs remarkably from both *E. crosnieri* and *E. holthuisi* by the dorsal carapace entirely covered with small dots.

The coloration of the French Polynesian specimen showed in Poupin *et al.* (1990, pl. IIIc) and Poupin (1996, pl. Vh) clearly depicts the present new species. Several photographs on a specimen collected from the Timor Sea (by lobster trap at about 100 m deep) near Darwin of Australia received from A. J. Bruce (pers. comm.) also show the coloration of *E. crosnieri*. Therefore, this new species is known from Taiwan, the Timor Sea and the French Polynesia. It is likely that *E. crosnieri* may later prove to be widely distributed in the western and southern Pacific or even Indo-West Pacific.

The genus *Enoplometopus* has recently received many attentions on its taxonomic affinity [*i.e.* from ranking it up to the superfamily level (de Saint Laurent 1988) or placing it under Axiidae (Holthuis 1983; Kensley & Child 1986) as well as separating it into two subgenera (Holthuis 1983; Kensley & Child 1986; Türkay 1989) or genera (de Saint Laurent 1988; Poupin *et al.* 1990; Poupin 1996)]. There is no intention to discuss further on these subjects in views of the insufficient specimens available and many species being still poorly known. This genus is here placed under Nephropoidea mainly referring to the close resemblance in the general appearances of these animals, may it be just for convenience. On the other hand, the intermediate characters of the present new species at least diminish one (*i.e.* the number of intermediate teeth) of the four characters used before to define the two "subgenera" of these interesting lobsters.

The holotype was alive when collected in January 1997. It was a berried female but the eggs quickly shaded after it was transferred to an aquarium in the laboratory. The animal readily accepted various kinds of food such as fish and shrimp meats as well as frozen adult artemia. It was very aggressive and whenever something approached its tank it would be immediately face the approaching object and viciously wave its massive claws. The animal molted on 10 April 1997 and died on 8 May 1997 of an unknown cause, after being held in the laboratory for about four months.

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The first stage zoea of *Pseudoliomera speciosa* (Dana, 1852) (Crustacea, Decapoda, Brachyura, Xanthidae)

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KEY WORDS
Crustacea,
Decapoda,
Brachyura,
Xanthidae,
Actaeinae,
first stage zoea,
Pseudoliomera speciosa.

ABSTRACT
The first zoeal stage of *Pseudoliomera speciosa* (Dana, 1852) is described, illustrated and compared with known first stage zoeas of the Xanthidae MacLeay, 1838 subfamily Actaeinae Alcock, 1898. No first stage zoeal character or combination of characters defining the Actaeinae was found.

MOTS CLÉS
Crustacea,
Decapoda,
Xanthidae,
Actaeinae,
premier stade zoé,
Pseudoliomera speciosa.

RÉSUMÉ
Le premier stade zoé de Pseudoliomera speciosa *(Dana, 1852) (Crustacea, Decapoda, Brachyura, Xanthidae).* Le premier stade zoé de *Pseudoliomera speciosa* est décrit, illustré et comparé avec les premiers stades zoés des Xanthidae MacLeay, 1838 de la sous-famille Actaeinae Alcock, 1898. Il n'a été trouvé aucun caractère ou combinaison de caractères du premier stade zoé qui puisse définir les Actaeinae.

INTRODUCTION

Of the fourteen genera assigned by Serène (1984: 20) to the Xanthidae MacLeay, 1838 subfamily Actaeinae Alcock, 1898, the first zoea is described for four. Recently an ovigerous crab of a fifth actaeine genus *Pseudoliomera speciosa* (Dana, 1852) was collected from Mauritius and the first stage zoeas were hatched in the laboratory. The purpose of this study is to compare the chaetotaxy of *P. speciosa* with known Actaeinae first stage zoeas.

MATERIALS AND METHODS

The ovigerous *Pseudoliomera speciosa* (Dana, 1852) was collected by SCUBA diving from Albion Rocks, Baie de la Petite Rivière, off Victory Road, Petite Rivière, Albion, Mauritius, *ca.* 20°12.5'S - 57°23.5'E, 3-7 m, 15 May 1995. The female was held in the Mauritius Fisheries Research Centre Laboratory at about 25 °C until the eggs hatched on eighteenth to nineteenth May 1995. The first stage zoeas were preserved in alcohol and the spent female, together with the remaining undissected zoeas, were deposited in The Natural History Museum, London under the registration number 1997.1.

The first stage zoeas were not stained and dissected appendages were mounted in Polyvinyl lactophenol using a WILD M5 binocular microscope with a supplementary lens (× 2). The cover slips of the slides were sealed with clear Sally Hansen nail varnish and the appendages were drawn using an OLYMPUS BH-2 microscope equipped with Nomarski interference contrast and attached *camera lucida*. Five replicates of each appendage were dissected to complete setal observations. The long plumose natatory setae of the first and second maxilliped are drawn truncated. The sequence of the zoeal description is based on the malacostracan somite plan and described from anterior to posterior. Setal armature on appendages is described from proximal to distal segments and in order of endopod to exopod.

Pseudoliomera speciosa (Dana, 1852)
(Figs 1-4)

DESCRIPTION

Zoea I

Carapace (Fig. 1A, E, F): dorsal spine curved with many small spines, longer than rostral spine; rostral spine shorter than dorsal spine, fractionally longer than antennal protopod, armed with spines; lateral spines present and armed with spines on dorsal margin; one pair of posterodorsal setae; ventral margin without setae; anterodorsal surface of carapace sparsely covered with small spines; eyes sessile.

Antennule (Fig. 1B): uniramous, endopod absent; exopod unsegmented with four terminal aesthetascs (two broad and long, two shorter and slender) plus one small terminal seta.

Antenna (Fig. 1C, D): protopod distally spinulate, fractionally shorter in length than rostral spine; endopod reduced to a small spine; exopod rudimentary, unsegmented, with one long subterminal and two terminal setae unequal in length.

Mandible: palp absent.

Maxillule (Fig. 2A): coxal endite with seven setae; basial endite with five terminal setal processes and two small teeth; endopod 2-segmented, proximal segment with one seta; distal segment with six (2 subterminal + 4 terminal) setae; exopod seta absent.

Maxilla (Fig. 2B): coxal endite bilobed with 4 + 4 setae; basial endite bilobed with 5 + 4 setae; endopod bilobed with 3 + 5 (2 subterminal + 3 terminal) setae; exopod (scaphognathite) margin with four setae and one long distal stout process.

First maxilliped (Fig. 3A): coxa without setae; basis with ten setae arranged 2, 2, 3, 3; endopod 5-segmented with 3, 2, 1, 2, 5 (1 subterminal + 4 terminal) setae respectively; exopod 2-segmented, distal segment with four long terminal plumose natatory setae.

Second maxilliped (Fig. 3B): coxa without setae; basis with four setae; endopod 3-segmented, with 1, 1, 6 (3 subterminal + 3 terminal) setae respectively; exopod 2-segmented, distal segment with four long terminal plumose natatory setae.

Third maxilliped: absent.

Pereiopods: absent.

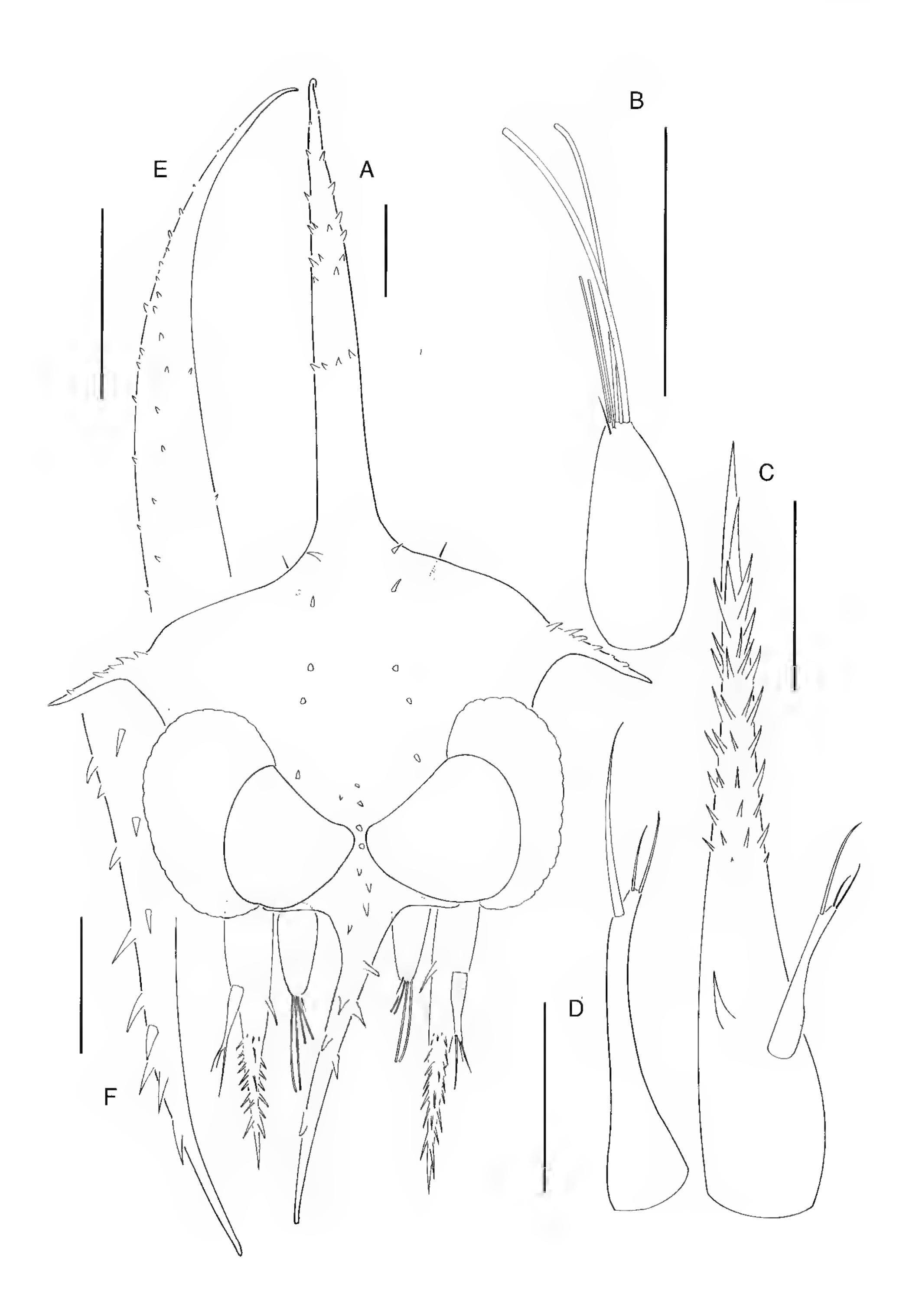


FIG. 1. — *Pseudoliomera speciosa* (Dana, 1852): zoea I. **A**, anterior view of carapace; **B**, antennule; **C**, antenna; **D**, antennal exopod; **E**, dorsal spine; **F**, rostral spine. Scale bars: A-C, E, F, 0.1 mm; D, 0.05 mm.

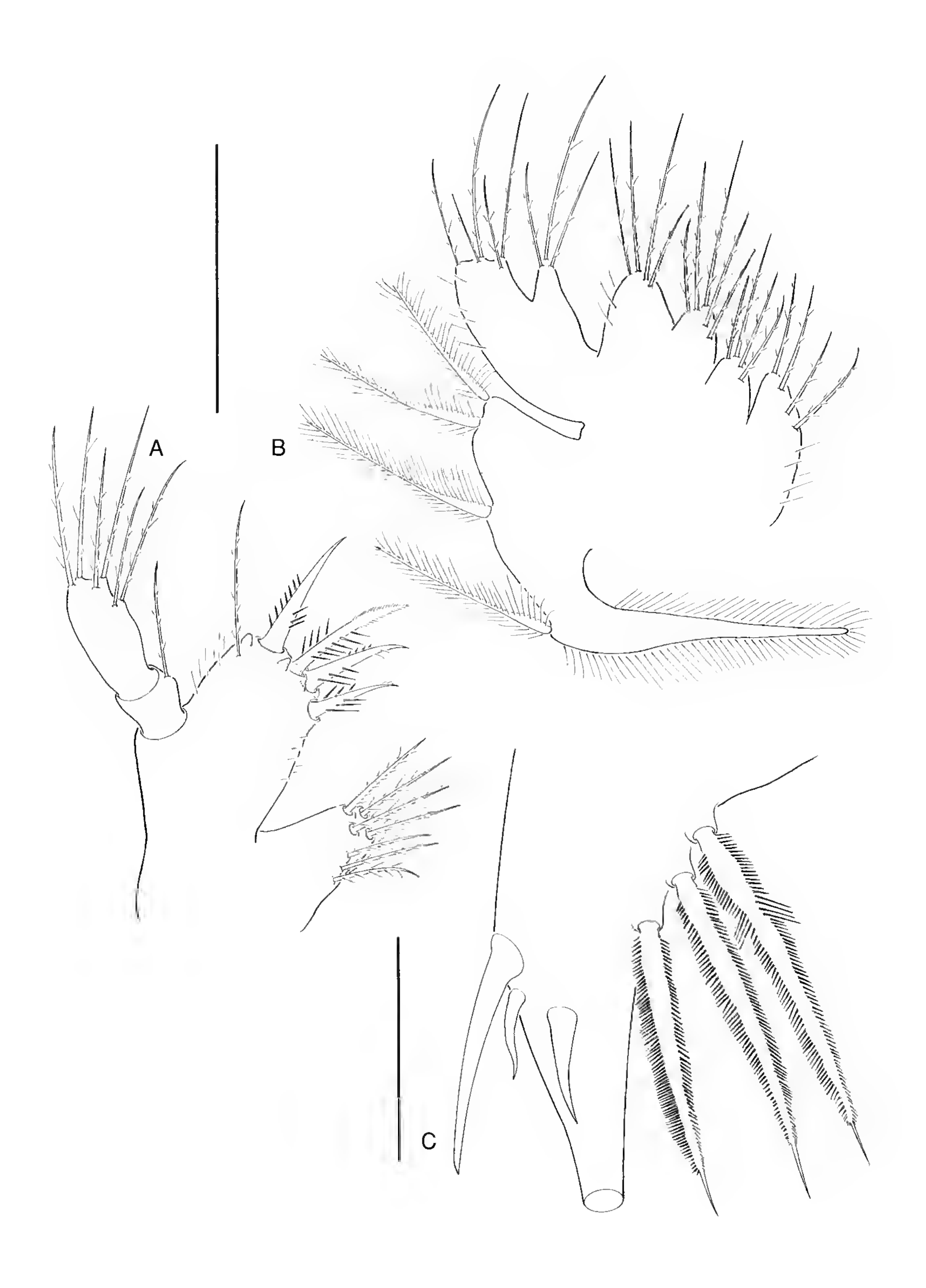


FIG. 2. — *Pseudoliomera speciosa* (Dana, 1852): zoea I. **A**, maxillule; **B**, maxilla; **C**, telson. Scale bars: 0.1 mm.

Abdomen (Fig. 4A, B): five somites; somite 2 with a pair of dorsolateral processes directed anteriorly; somite 3 with a pair of dorsolateral processes directed ventrally; somites 1-2 with rounded posterolateral processes and somites 3-5 with short posterolateral spinous processes; somite 1 without setae; somites 2-5 with one pair of posterodorsal setae; pleopod buds absent.

Telson (Figs 2C, 4A, B): each telson fork long, gradually curved distally; one long and one sigmoid lateral spine; dorsal medial spine present; posterior margin with three pairs of stout spinulate setae.

DISCUSSION

Clark & Ng (1998, table 1) tabulated first stage zoeal characters that, used in combination, might define the Xanthidae MacLeay, 1838 and the zoea I of *Pseudoliomera speciosa* described in this study is fully in accord with this definition. The first stage zoea of *Pseudoliomera speciosa* exhibits a distinctive spinulation of the anterodorsal carapace surface that separates it from known Actaeinae zoea I larvae.

Clark & Ng (1998) suggest that the carapace spine armature, the antenna and spinulation of the telson forks may provide distinguishing characters for xanthid taxa below the family level, at the first zoea stage. These characters were examined in the first stage zoeas of *Actaea semblatae* Guinot, 1976 [as *Actaea savignyi* (H. Milne Edwards, 1834)] by Terada (1987); *Novactaea pulchella* (A. Milne-Edwards, 1865) by Terada (1990); *Gaillardiellus orientalis* (Odhner, 1925) by Ng & Clark (1994); *Actaeodes hirsutissimus* (Rüppell, 1830) and *A. tomentosus* (H. Milne

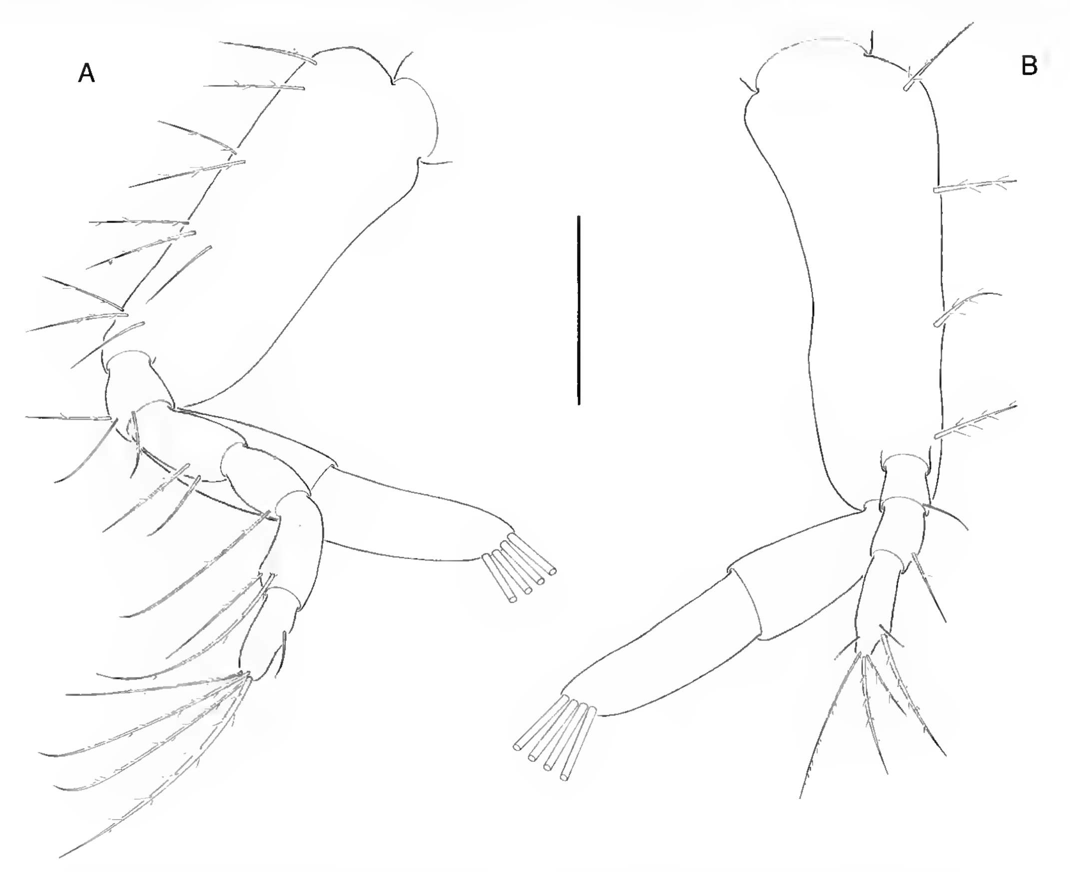


FIG. 3. — *Pseudoliomera speciosa* (Dana, 1852): zoea I. **A**, first maxilliped; **B**, second maxilliped. Scale bar: 0.1 mm.

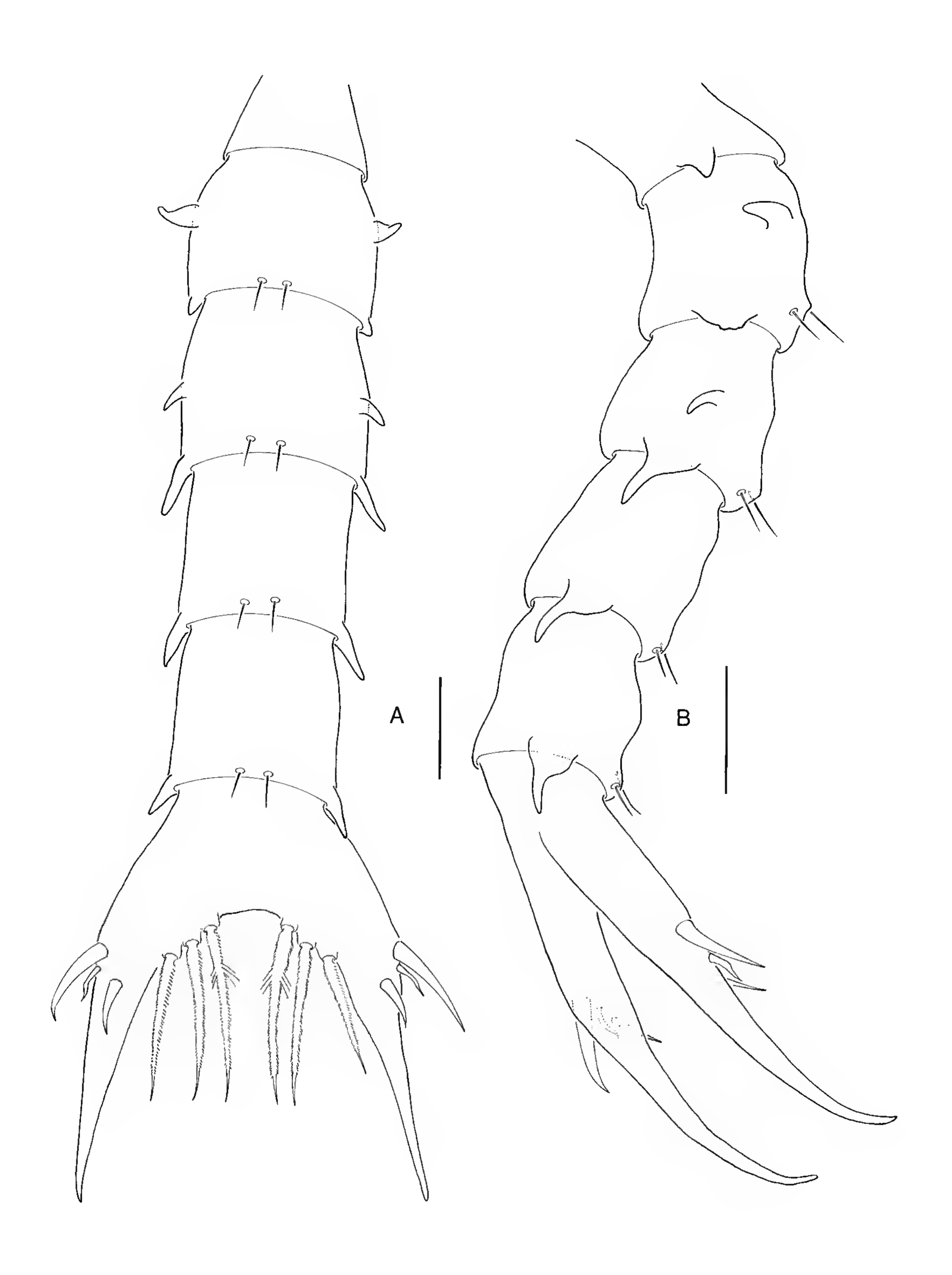


FIG. 4. — *Pseudoliomera speciosa* (Dana, 1852): zoea I abdomen. **A**, dorsal view; **B**, lateral view. Scale bars: 0.1 mm.

Edwards, 1834) both by Clark & Al-Aidaroos (1996)] and from *Pseudoliomera speciosa* described in the present study in order to establish subfamilial characters diagnostic of first stage Actaeinae zoea. All these first stage zoeas conform with the Xanthidae characters listed by Clark & Ng (1998, table 1).

Carapace spine armature

The carapace spines of *Pseudoliomera speciosa* (this study, Fig. 1A, E, F) are spinulate, the dorsal has numerous minute spines, the rostral has a number of well-developed spines distally and the lateral are spinulate on the dorsal margin. In comparison only the rostral spine of *Actaeodes tomentosus* and *A. hirsutissimus* first stage zoeas, as described by Clark & Al-Aidaroos (1996, fig. 1A-C), is spinulate, and the dorsal and lateral spines are smooth. The dorsal and rostral spines of *Novactea pulchella* appear proportionately longer (Terada 1990, fig. 5A1) when compared with *Actaeodes*, and the rostral spine is smooth. The carapace spines of *Gaillardiellus orientalis* (Ng & Clark 1994, fig. 1A) are naked but distinctive with rounded swollen tips on the dorsal and lateral spines. All the carapace spines of *Actaea semblatae*, as described by Terada (1987, fig. 11, A1), are devoid of spinulation and have pointed tips.

Antenna

The antenna of *P. speciosa* (see this study Fig. 1D) is identical to that of *Actaeodes tomentosus* (Clark & Al-Aidaroos 1996, fig. 1F, G) and is differentiated from *A. hirsutissimus* (Clark & Al-Aidaroos 1996, fig. 1E, H) by the exopod setation, instead of one long subterminal and two unequal setae, the latter species possesses only one terminal seta. An endopod reduced to a small spine is characteristic of these three species. In *N. pulchella*, the antennal exopod (Terada 1990, fig. 5C1) is similar to *P. speciosa*, but the protopod is naked and the endopod well-developed. Ng & Clark (1994, fig. 1C, D) illustrated a smooth protopod for *G. orientalis* with a distinctive swollen tip that is devoid of an endopod, although the exopod is similar to *P. speciosa* and *A. tomentosus*. The antenna of *Actaea semblatae* figured by Terada (1987, fig. 11, A1) depicts a smooth protopod without a swollen tip, the endopod is present and the exopod is reduced to a single seta.

Spinulation of telson forks

All the telson fork spines of *P. speciosa* are prominent, with the distal lateral spine sigmoid in shape (this study, Fig. 2C). The proximal lateral and the dorsal telson spines of *Actaeodes tomentosus* are prominent with a slightly smaller distal lateral spine (Clark & Al-Aidaroos 1996, fig. 3E). By comparison, the telson armature of *A. hirsutissimus* (Clark & Al-Aidaroos 1996, fig. 3D) and *N. pulchella* (Terada 1990, fig. 3H1) is similar except that the distal lateral spine is considerably reduced. The telson armature of *G. orientalis* (Ng & Clark 1994, fig. 2C) and *Actaea semblatae* (Terada 1987, fig. H1, I1) comprises setae, not spines as described for the other species.

From the existing descriptions of known actaeine first stage zoeas and this study, no single character or suite of characters appears to define the Actaeinae.

Acknowledgements

We wish Alain Crosnier a happy retirement and thank him for his support. This study could not have been undertaken without the help of the Fishery Officers at the Albion Fisheries Research Centre, Ministry of Fisheries and Marine Resources, Petite Rivière, Albion, Mauritius and the logistical support provided by the Smithsonian Institution.

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The larval development of the poisonous mosaic crab, *Lophozozymus pictor* (Fabricius, 1798) (Crustacea, Decapoda, Brachyura, Xanthidae, Zosiminae), with comments on familial characters for first stage zoeas

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KEY WORDS
Crustacea,
Decapoda,
Brachyura,
Xanthidae,
first stage zoea,
familial diagnostic characters,
Lophozozymus,
Palapedia.

ABSTRACT

The four zoeal stages and megalopal phase of the xanthid crab *Lophozozymus pictor* (Fabricius, 1798) are described and fully illustrated. A comparison between the zoeal stages of *L. pictor* and *Atergatis reticulatus* is tabulated. Characters selected from larvae representing six subfamilies, which may define first stage Xanthidae MacLeay, 1838 (*sensu* Serène, 1984) zoea, are listed. The first stage zoeal appendages of *Palapedia valentini* Ng, 1993, considered to be diagnostic of a new Xanthidae subfamily Kraussiinae Ng, 1993, are reappraised and the chaetotaxy of the antennal exopod as a diagnostic character of the Xanthidae MacLeay, 1838 (*sensu* Serène, 1984) is discussed.

MOTS CLÉS
Crustacea,
Decapoda,
Brachyura,
Xanthidae,
premier stade zoé,
caractères familiaux,
Lophozozymus,
Palapedia.

RÉSUMÉ

Le développement larvaire du crabe vénéneux, Lophozozymus pictor *(Fabricius, 1798) (Crustacea, Decapoda, Brachyura, Xanthidae, Zosiminae), et commentaires sur les caractères familiaux des premiers stades zoés.* Les quatre stades zoés et la phase mégalope du crabe Xanthidae *Lophozozymus pictor* sont décrits et illustrés de manière détaillée. Les stades zoés de *L. pictor* et d'*Atergatis reticulatus* sont comparés sous forme de tableau. À partir des larves de six sous-familles, les caractères pouvant définir le premier stade zoé des Xanthidae MacLeay, 1838 (au sens de Serène 1984) sont énumérés. Les appendices du premier stade zoé de *Palapedia valentini* Ng, 1993, considérés comme caractéristiques d'une nouvelle sous-famille de Xanthidae, les Kraussiinae Ng, 1993, sont réexaminés et l'utilisation de la chétotaxie de l'exopodite antennaire comme caractère diagnostique des Xanthidae est discutée.

INTRODUCTION

The poisonous Indo-West Pacific reef crab *Lophozozymus pictor* (Fabricius, 1798) (Xanthidae) has been the subject of many studies, but most of the work has focused on its taxonomy and biology (Guinot 1977, 1979; Yasumoto *et al.* 1986; Llewellyn & Endean 1989). As part of the studies on the ecology and toxic nature of this species in Singapore (Chia *et al.* 1993; Ng *et al.* 1990, 1992), several ovigerous females were obtained. From one of these females, four zoeal stages and the megalop phase were reared in the laboratory and this present paper serves to describe and figure these larvae. This is the first larval account of a *Lophozozymus* species and only the second of the Zosiminae (*sensu* Serène 1984); see the description by Terada (1980) of *Atergatis reticulatus*. The opportunity is also taken to redescribe the first stage zoea of *Palapedia valentini* Ng, 1993 (Krausinae).

MATERIAL AND METHODS

The ovigerous female of *Lophozozymus pictor* was collected from a reef on Siloso Beach, Sentosa Island, Singapore, and is now deposited, together with remaining larvae, in the Zoological Reference Collection, National University of Singapore (ZRC 1997.771).

The ovigerous crab was isolated in a tank with strong aeration. First stage zoea hatched on the twenty-ninth January 1992 and development to megalop was completed by the end of February. The larvae were reared in 10 cm diameter plastic bowls in about 1 cm depth of 100% filtered sea water. All stages were fed with newly hatched brine shrimps (cysts filtered off). The water was changed daily and contained no additives. Average water temperature was about 26 °C. First and second zoeas were stocked at about twenty per bowl, third and fourth zoeas as well as the megalops at about ten per bowl. No crab stages were obtained. All specimens were initially preserved in buffered formalin and later transferred to 70% alcohol.

The larvae were dissected using an M5 Wild binocular microscope with a supplementary lens (× 2). Appendages were not stained and were mounted on slides using polyvinyl lactophenol. Cover slipes were sealed with clear Sally Hansen nail varnish. Setal observations and drawings were made using an Olympus BH2 microscope with Nomarski interference contrast and *camera lucida* attachment. The long aesthetascs on the antennules, and the long plumose setae on distal exopod segments are not fully illustrated but are drawn truncated. The dorsal carapace spines of the third and fourth stages are not illustrated because they appeared not to survive the preservation process and therefore any setation on these could not be recorded. The zoeal description is based on the malacostracan somite plan and is ordered from anterior to posterior. Setal armature on appendages is described from proximal to distal segments and in order of endopod to exopod.

Seven first stage, seven second stage, five third stage, five fourth stage zoeas and three megalops of *Lophozozymus pictor* were dissected for this study. However, of the three extant first stage zoea of *Palapedia valentini* deposited in the Zoological Reference Collection, National University of Singapore (ZRC 1997.770), only two specimens were prepared for the redescription of appendages.

Lophozozymus pictor (Fabricius, 1798)
(Figs 1-21)

Larval descriptions

Zoea I

Carapace (Fig. 1A): dorsal spine long and straight, spinulation absent; rostral spine slightly shorter than dorsal spine, approximately equal in length to the protopod of antenna, spinulation absent; lateral spines present, much shorter than rostral and curving ventrally; anterodorsal setae absent; one pair of posterodorsal setae; each ventral margin without setae; eyes sessile.

Antennule (Fig. 2A): uniramous, endopod absent; exopod unsegmented with two broad, long, two shorter, slender terminal aesthetascs and one terminal seta.

Antenna (Fig. 8A, B): protopodal process devoid of spinulation, approximately equal in length to

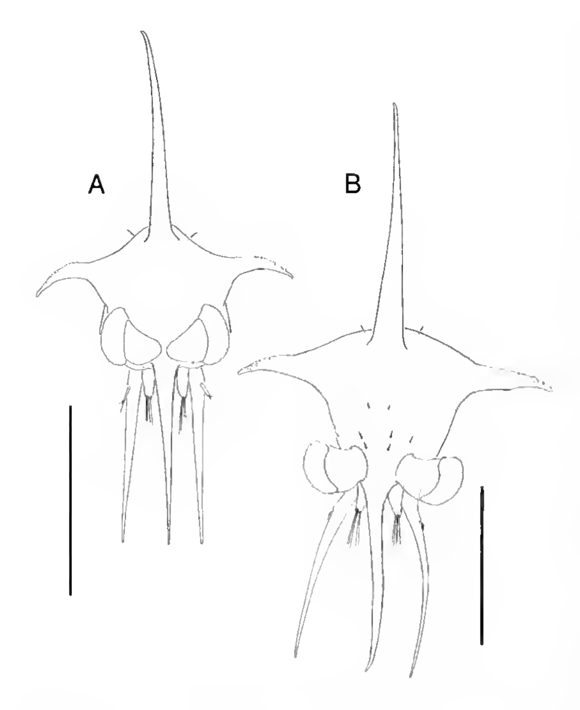


FIG. 1. — *Lophozozymus pictor* (Fabricius, 1798): anterior view of carapace; **A**, first zoea; **B**, second zoea. Scale bars: 1 mm.

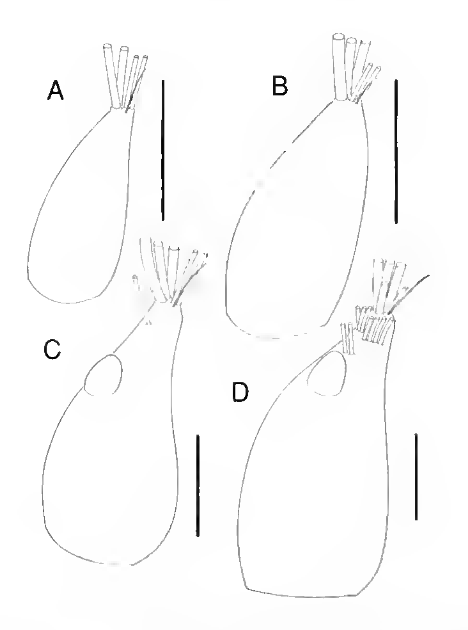


FIG. 2. — *Lophozozymus pictor* (Fabricius, 1798): antennule; **A**, first zoea; **B**, second zoea; **C**, third stage; **D**, fourth stage. Scale bars: 0.1 mm.

rostral spine; endopod absent; exopod rudimentary, unsegmented with three unequal setae, two smallest setae terminal, largest seta subterminal.
Mandible: palp absent.
Maxillule (Fig. 9A): coxal endite with seven setae; basial endite with five setal processes and two small teeth; endopod 2-segmented, proximal segment with one seta; distal segment with six (two subterminal, four terminal) setae; exopod seta absent.
Maxilla (Fig. 10A): coxal endite bilobed with 4 + 4 setae; basial endite bilobed with 5 + 4 setae; endopod bilobed with 3 + 5 (2 subterminal + 3 terminal) setae; exopod (scaphognathite) margin with four setae and one long distal stout process.
First maxilliped (Fig. 11A): coxa without setae; basis with ten setae arranged 2, 2, 3, 3; endopod 5-segmented with 3, 2, 1, 2, 5 (1 subterminal + 4 terminal) setae respectively; exopod 2-segmented, distal segment with four long terminal plumose natatory setae.
Second maxilliped (Fig. 12A): coxa without setae; basis with four setae; endopod 3-segmented, with 1, 1, 6 (3 subterminal + 3 terminal) setae respectively; exopod 2-segmented, distal segment with four long terminal plumose natatory setae.
Third maxilliped: absent.
Pereiopods: absent.
Abdomen (Figs 13A, 14A): five somites; somite 2 with one pair of dorsolateral processes directed anteriorly; somite 3 with one pair of dorsolateral processess directed posteriorly; somites 1-2 with short rounded and somites 3-5 with posterolateral spinous processes rudimentary; somites 2-5 with one pair of posterodorsal setae; pleopod buds absent.
Telson (Figs 13A, 14A, 15A): each fork long, gradually curved, not spinulated; two pairs of small lateral spines; one pair of dorsal medial spines larger than laterals; posterior margin with three pairs of stout spinulate setae.

Zoea II

Carapace (Figs 1B, 3A): four pairs of anterodorsal setae; each ventral margin with four setae (one plumose anterior seta and three non-plumose posterior setae); eyes stalked; otherwise unchanged.

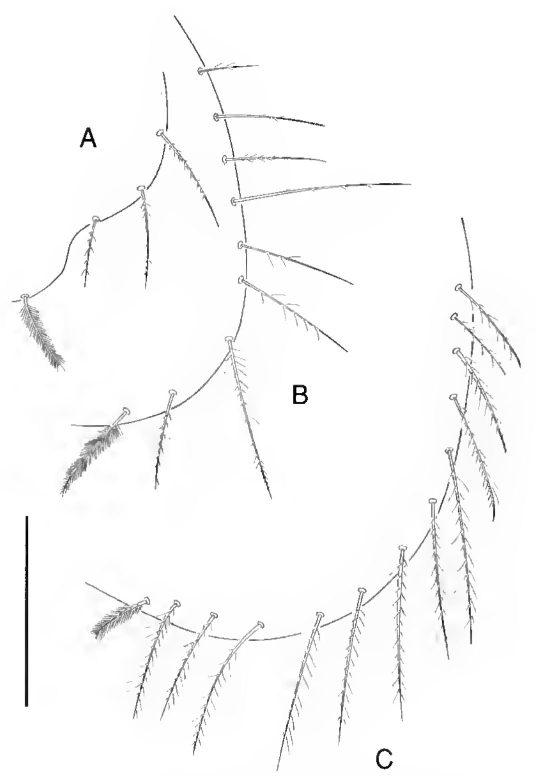


FIG. 3. — *Lophozozymus pictor* (Fabricius, 1798): chaetotaxy of ventral carapace margin; **A**, second zoea; **B**, third stage zoea; **C**, fourth stage zoea. Scale bar: 0.3 mm.

FIG. 4. — *Lophozozymus pictor* (Fabricius, 1798): anterior view of carapace, third zoea. Scale bar: 1 mm.

Antennule (Fig. 2B): exopod with one additional broad, long aesthetasc; otherwise unchanged.
Antenna (Fig. 8C, D): endopod present; exopod reduced; otherwise unchanged.
Mandible: unchanged.
Maxillule (Fig. 9B): coxal endite with eight distinct setae; basial endite with eight setal processes, inner margin with teeth no longer prominent; endopod unchanged; exopod seta present.
Maxilla (Fig. 10B): exopod (scaphognathite) margin with thirteen setae, long distal stout process no longer prominent; otherwise unchanged.
First maxilliped (Fig. 11B): exopod distal segment with six long terminal plumose natatory setae; otherwise unchanged.
Second maxilliped (Fig. 12B): exopod distal segment with six (occasionally seven) long terminal plumose natatory setae; otherwise unchanged.

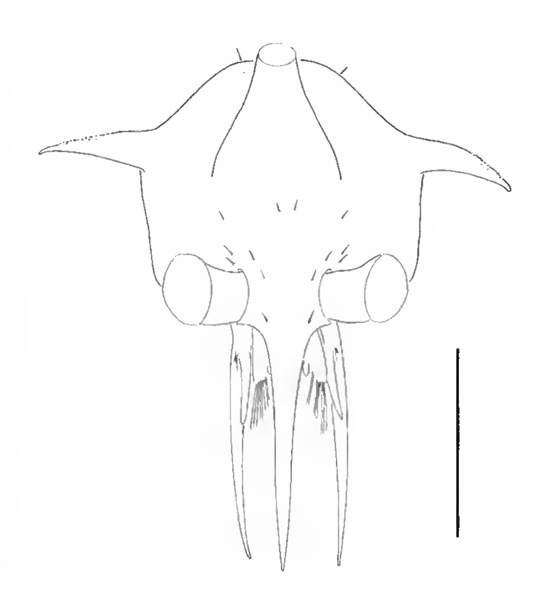


FIG. 5. — *Lophozozymus pictor* (Fabricius, 1798): anterior view of carapace, fourth zoea. Scale bar: 1 mm.

Fig. 6. — *Lophozozymus pictor* (Fabricius, 1798); **A**, lateral view of megalop carapace; **B**, dorsal view of megalop carapace; **C**, megalop antennule. Scale bars: A, B, 1 mm; C, 0.1 mm.

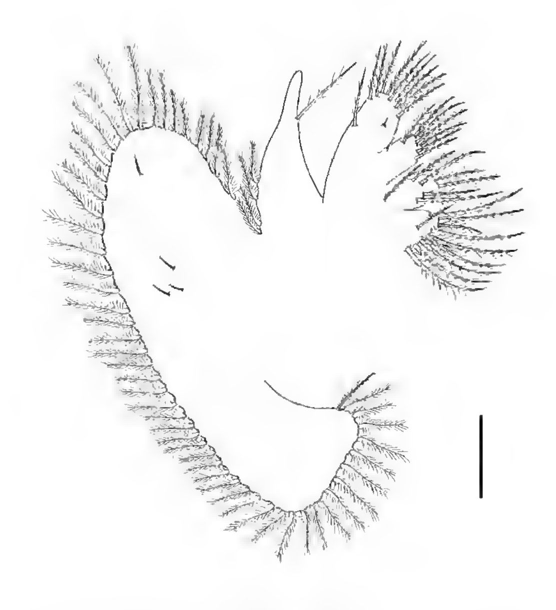


Fig. 7. — *Lophozozymus pictor* (Fabricius, 1798): maxilla of megalop. Scale bar: 0.1 mm.

Third maxilliped: absent.
Pereiopods: absent.
Abdomen (Figs 13B, 14B): somites 3-5 with posterolateral spinous processes more developed; somite 1 with one medial seta; otherwise unchanged.
Telson (Figs 13B, 14B, 15D): posterior margin with three pairs of stout spinulate setae plus one pair of medial setae; otherwise unchanged.

Zoea III

Carapace (Figs 3B, 4): six pairs of anterodorsal setae; each ventral margin with nine setae (one plumose anterior seta and eight non-plumose posterior setae); otherwise unchanged.
Antennule (Fig. 2C): biramous; endopod bud present; exopod with one additional subterminal aesthetasc; otherwise unchanged.
Antenna (Fig. 8E, F): endopod longer; exopod reduced; otherwise unchanged.
Mandible: unchanged.
Maxillule (Fig. 9C): coxal endite with nine setae; basial endite with eleven setal processes; otherwise unchanged.
Maxilla (Fig. 10C): coxal endite with 5 + 4 setae; basial endite bilobed with 5 + 5 setae; endopod

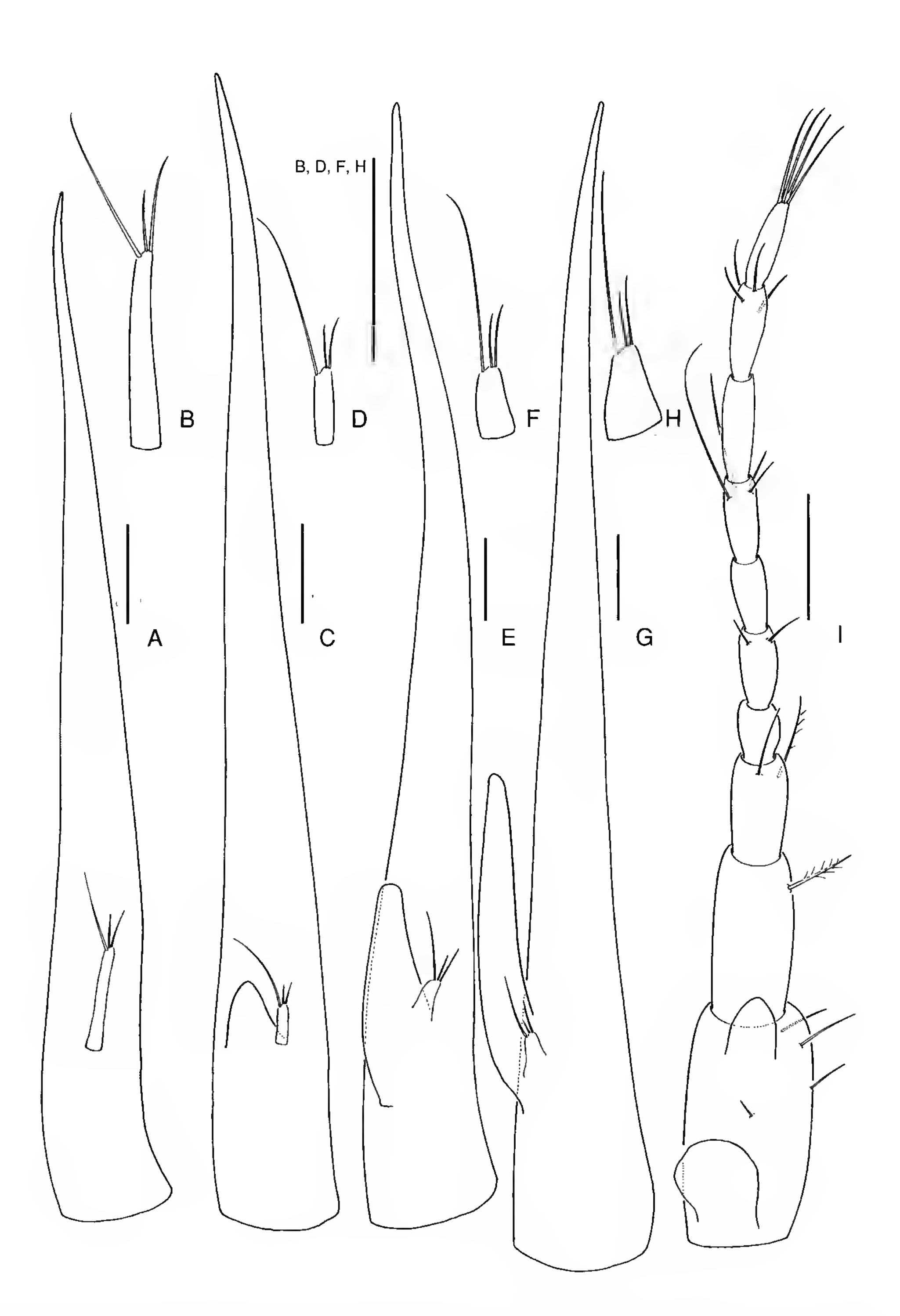


Fig. 8. — *Lophozozymus pictor* (Fabricius, 1798): A, C, E, G, I, antenna; B, D, F, H, antennal exopod; **A**, **B**, first zoea; **C**, **D**, second zoea; **E**, **F**, third zoea; **G**, **H**, fourth zoea; **I**, megalop. Scale bars: 0.1 mm.

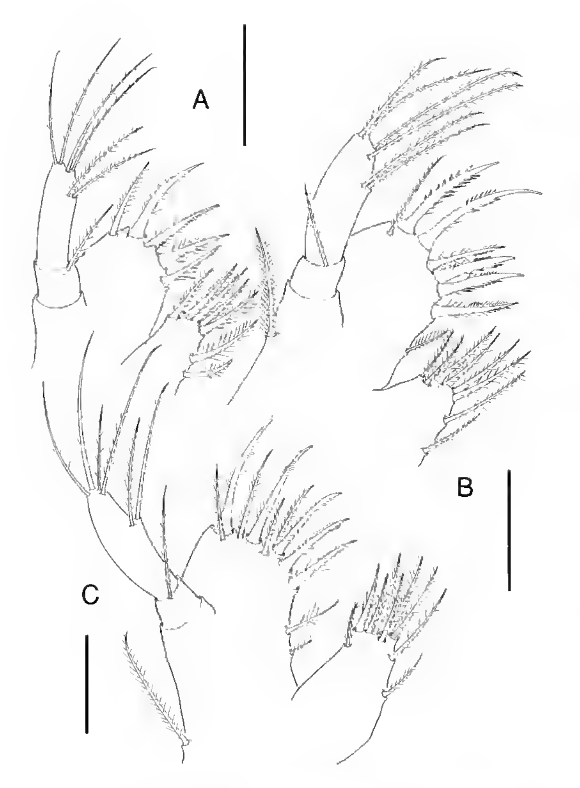


Fig. 9. — *Lophozozymus pictor* (Fabricius, 1798): maxillule; **A**, first zoea; **B**, second zoea; **C**, third zoea. Scale bars: 0.1 mm.

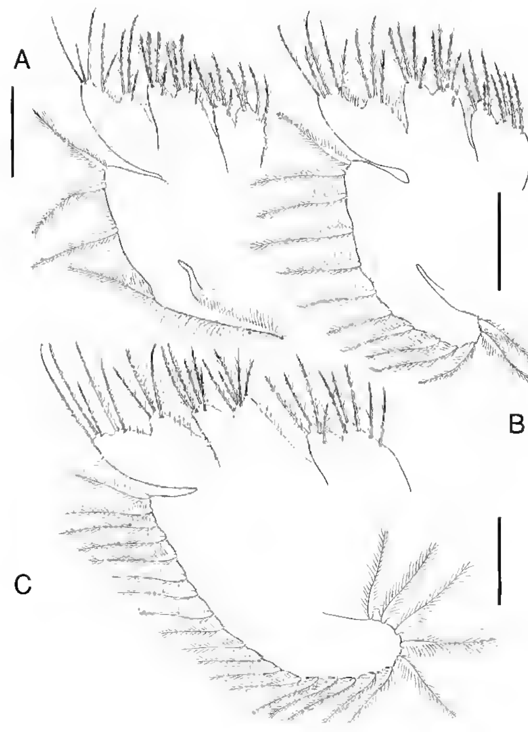


Fig. 10. — *Lophozozymus pictor* (Fabricius, 1798): maxilla; **A**, first zoea; **B**, second zoea; **C**, third zoea. Scale bars: 0.1 mm.

unchanged; exopod (scaphognathite) margin with twenty-three setae.

First maxilliped (Fig. 18A): endopod distal segment now with six (two subterminal and four terminal) setae; exopod distal segment with eight long terminal plumose natatory setae; otherwise unchanged.

Second maxilliped (Fig. 19A): exopod distal segment with nine long terminal plumose natatory setae; otherwise unchanged.

Third maxilliped (Fig. 17A): present, rudimentary and biramous; endopod slightly longer than exopod.

Pereiopods (Fig. 16C): present, rudimentary, undifferentiated into segments; cheliped bilobed; gills present on pereiopods 1-3.

Abdomen (Figs 13C, 14C): 6-segmented; somites 3-5 with posterolateral spinous processes more pronounced and extended posteriorly; somite 1 with three setae; somite 6 without setae; pleopod buds present on somites 2-6, uniramous with endopods absent; otherwise unchanged.

Telson (Figs 13C, 14C, 15C): posterior margin with three pairs of stout spinulate setae plus two pairs of medial setae; otherwise unchanged.

Zoea IV

Carapace (Figs 3C, 5): seven pairs of anterodorsal setae; each ventral margin with thirteen setae (one plumose anterior seta and twelve non-plumose posterior setae); otherwise unchanged.

Antennule (Fig. 2D): endopod unchanged; exopod now with 2 + 7 thin subterminal aesthetascs, terminal aesthetascs unchanged.

Antenna (Fig. 8G, H): endopod longer; exopod reduced; otherwise unchanged.

Mandible (Fig. 16A): palp present.

Maxillule (Fig. 17D): coxal endite with twelve setae; basial endite with thirteen setal processes; otherwise unchanged.

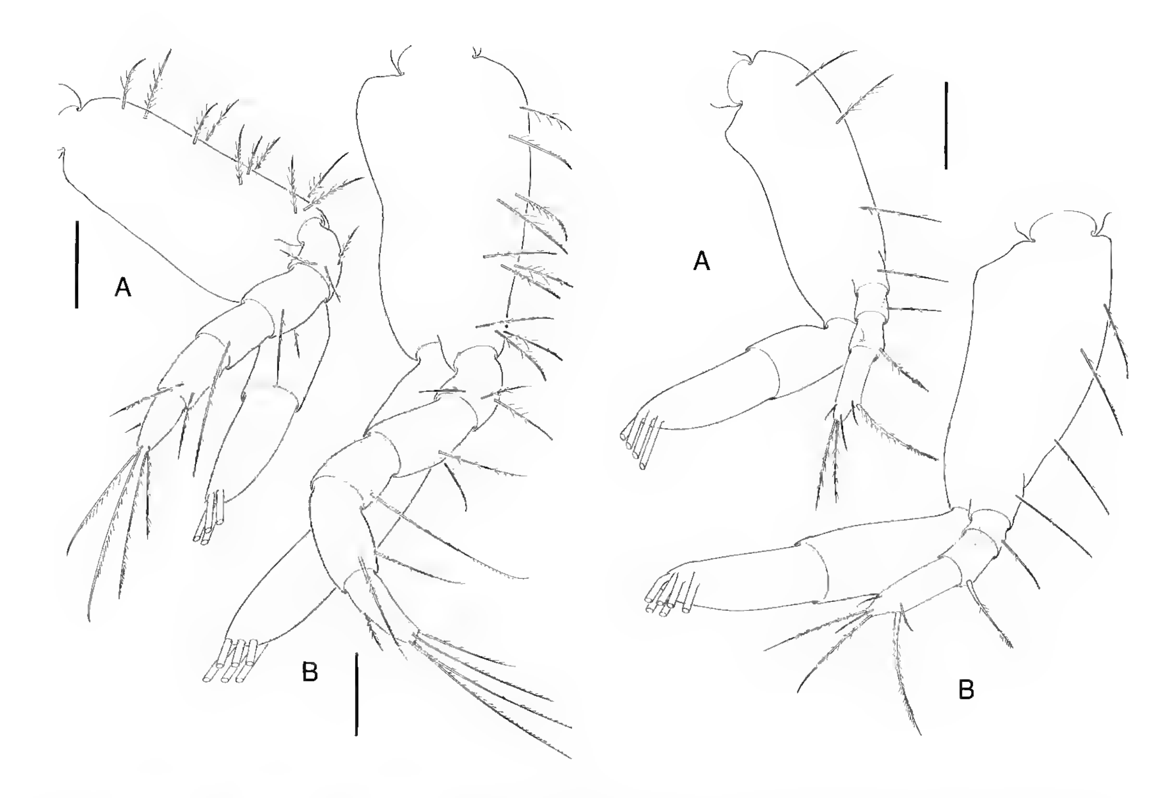


Fig. 11. — *Lophozozymus pictor* (Fabricius, 1798): first maxilliped; **A**, first zoea; **B**, second zoea. Scale bars: 0.1 mm.

Fig. 12. — *Lophozozymus pictor* (Fabricius, 1798): second maxilliped; **A**, first zoea; **B**, second zoea. Scale bar: 0.1 mm.

Maxilla (Fig. 17F): coxal endite unchanged; basial endite bilobed with 5 + 7 setae; endopod unchanged; exopod (scaphognathite) margin with thirty-two setae.
First maxilliped (Fig. 18B): exopod distal segment with ten long terminal plumose natatory setae; otherwise unchanged.
Second maxilliped (Fig. 19B): exopod distal segment with eleven long terminal plumose natatory setae; otherwise unchanged.
Third maxilliped (Fig. 17B): developing; otherwise unchanged.
Pereiopods (Fig. 16D-H): developing with differentiation of segments, segments without setae; gill appendages not discernible.
Abdomen (Figs 17G, 20A, C, E, G, I, K): posterolateral spinous processes more pronounced and extended posteriorly; pleopods biramous with endopods present except on pleopod 5 (somite 6); otherwise unchanged.
Telson (Figs 17G, 20A, M): posterior margin with three pairs of stout spinulate setae plus four pairs of medial setae; one pair of medial setae present on dorsal surface; otherwise unchanged.

Megalop
Carapace (Fig. 6A, B): short rostrum deflected posteriorly; setation as figured.
Antennule (Fig. 6C): peduncle 3-segmented with 1, 1, 4 (2 short + 2 long) setae respectively; endopod 1-segmented with five terminal setae; exopod 4-segmented, segments 2, 3, 4, with 9, 8 and 4 (subterminal) aesthetascs respectively, segments 3, 4 with 2, 2 (1 subterminal, 1 terminal) setae respectively.
Antenna (Fig. 8I): 3-segmented peduncle with 4, 1, 2 setae respectively; 7-segmented flagellum with 0, 2, 0, 4, 0, 4, 4 (terminal) setae respectively.
Mandible (Fig. 16B:) palp 3-segmented, distal segment with eleven marginal setae.

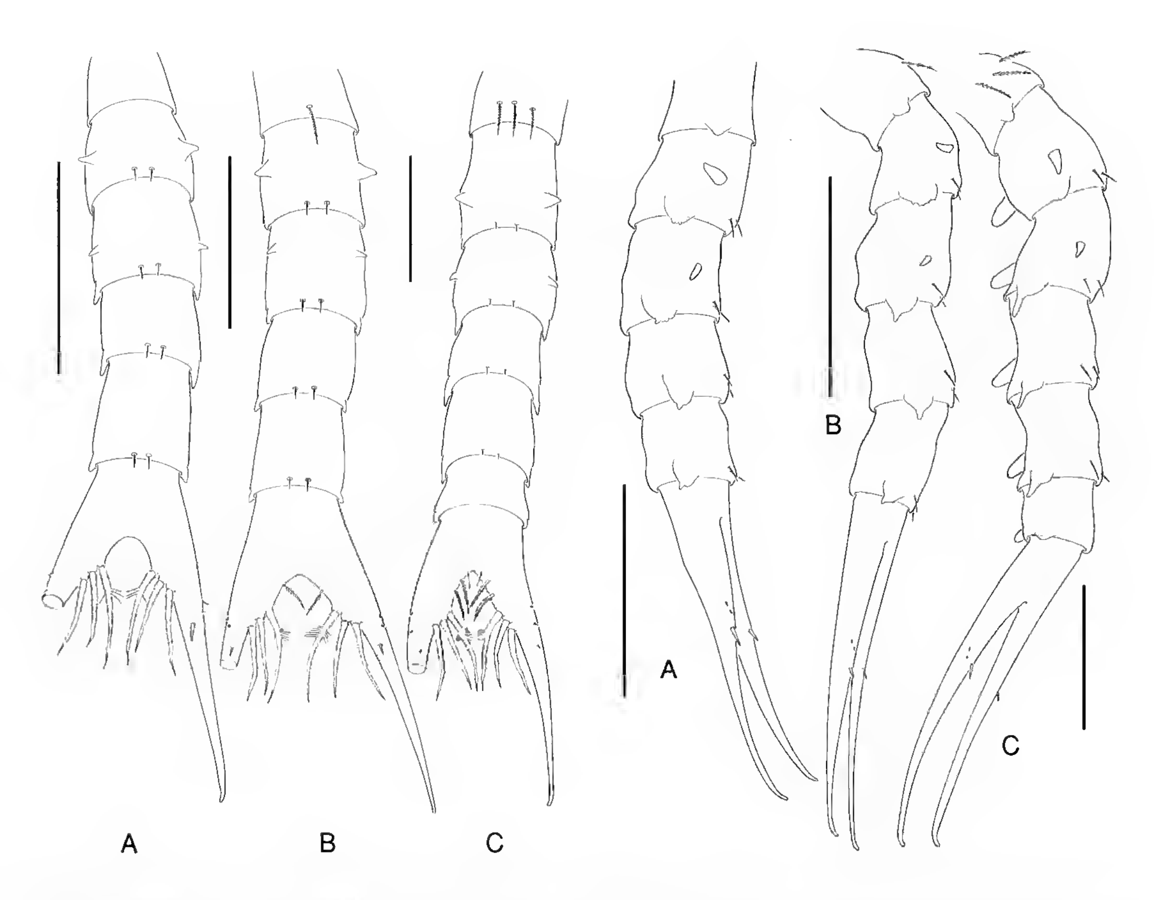


FIG. 13. — *Lophozozymus pictor* (Fabricius, 1798): dorsal view of abdomen; **A**, first zoea; **B**, second zoea; **C**, third zoea. Scale bars: 0.5 mm.

FIG. 14. — *Lophozozymus pictor* (Fabricius, 1798): lateral view of abdomen; **A**, first zoea; **B**, second zoea; **C**, third zoea. Scale bars: 0.5 mm.

Maxillule (Fig. 17E): coxal endite with seventeen setae; basial endite with twenty-two setal processes; endopod 2-segmented, proximal segment with three setae, distal segment with four (two subterminal and two shorter terminal) setae.

Maxilla (Fig. 7): coxal endite bilobed with 10 + 7 setae; basial endite bilobed with 7 long, 1 minute + 10 long, 1 minute setae; endopod simple with 1 subterminal seta + 4 setae on the lower external margin; exopod (scaphognathite) margin with fifty-three setae and four lateral setae.

First maxilliped (Fig. 21A): epipod with thirteen long setae; coxal endite with fourteen setae; basial endite with twenty-four setae; endopod unsegmented with four setae and a small terminal spine; exopod 2-segmented, proximal segment with one proximal and one distal seta; distal segment with one small subterminal seta and seven long terminal plumose feeding setae.

Second maxilliped (Fig. 21B): epipod with eleven long setae; prodobranch gill present; coxa and basis not differentiated, with two setae; endopod 5-segmented, ischium with two setae, merus with three setae, carpus with one seta, propodus with six setae, dactylus with seven setae; exopod 2-segmented, proximal segment with two marginal medial setae; distal segment with five long terminal plumose feeding setae.

Third maxilliped (Fig. 17C): epipod with twenty-three long setae and arthrobranch gill; coxa and basis not differentiated, with twenty-four setae; ischium inner margin with six teeth and twenty-two setae; merus with sixteen setae; carpus with

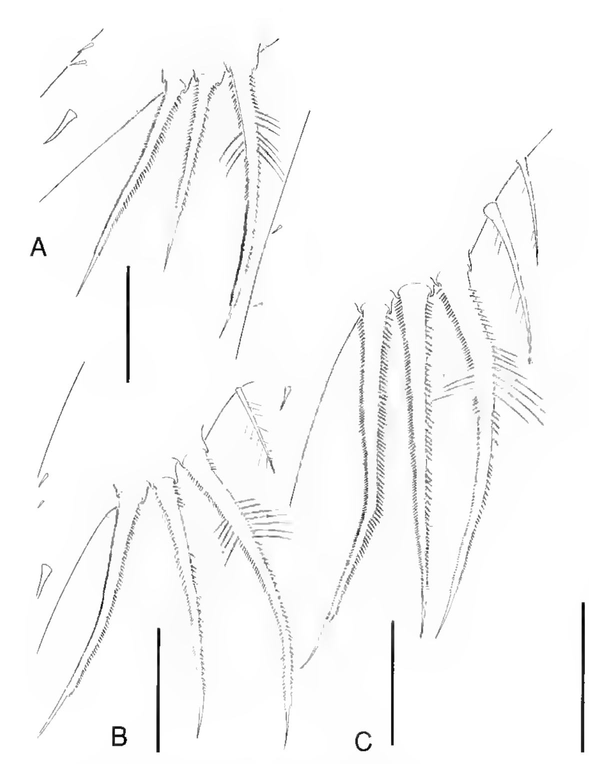


Fig. 15. — *Lophozozymus pictor* (Fabricius, 1798): dorsal view of telson; **A**, first zoea; **B**, second zoea; **C**, third zoea. Scale bars: 0.1 mm.

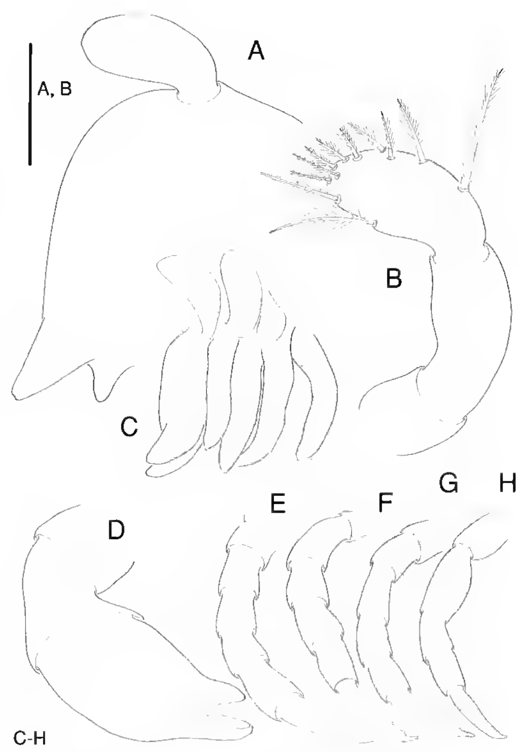


Fig. 16. — *Lophozozymus pictor* (Fabricius, 1798): mandibular palp; **A**, fourth zoea; **B**, megalop, pereiopods; **C**, third zoea; **D-H**, fourth zoea. Scale bars: A, B, 0.1 mm; C-H, 0.5 mm.

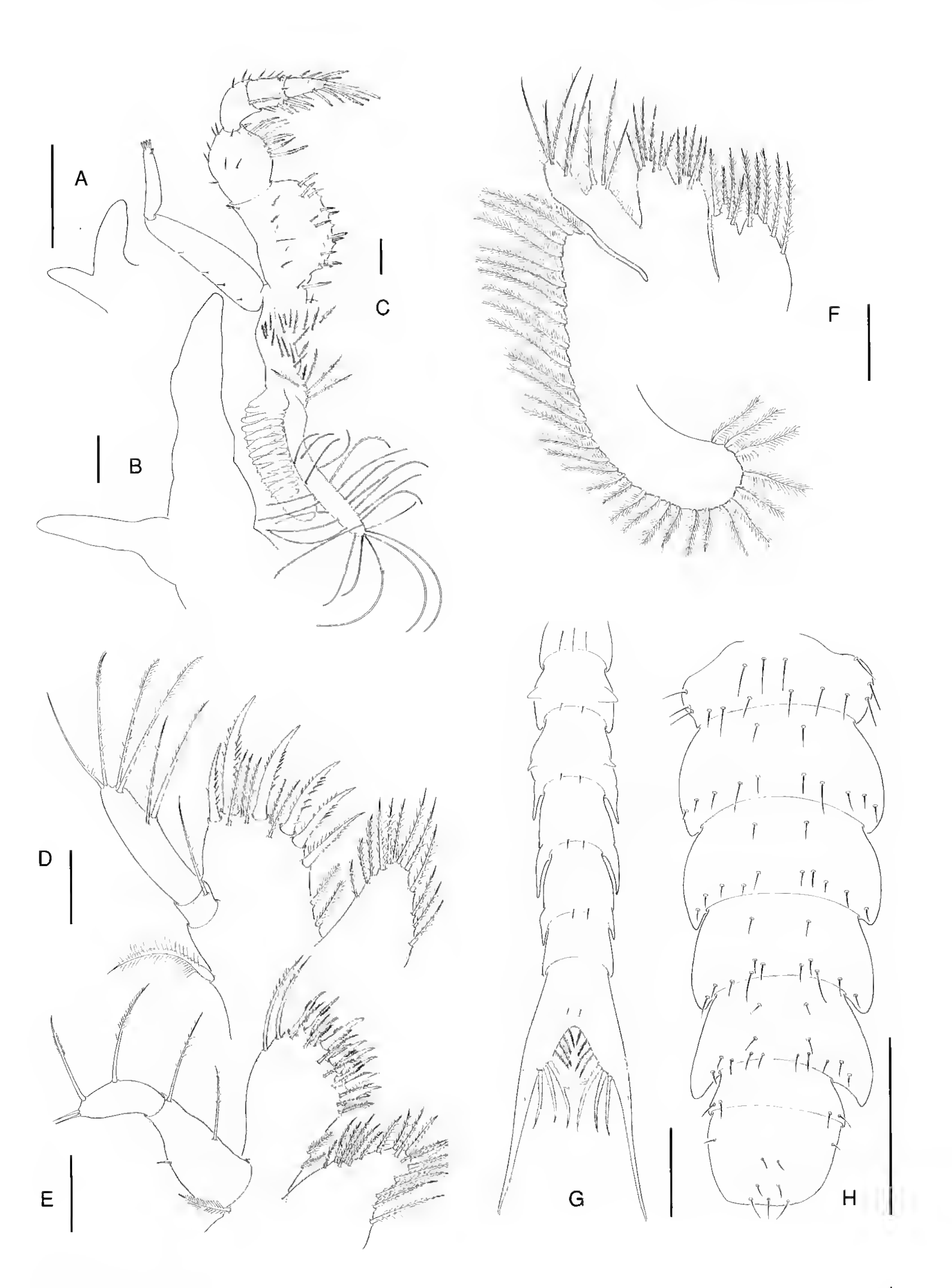
eight setae; propodus with ten setae; dactylus with eight setae; exopod 2-segmented, proximal segment with four marginal setae, distal segment with two minute subterminal spines and five long terminal plumose raptatory setae.

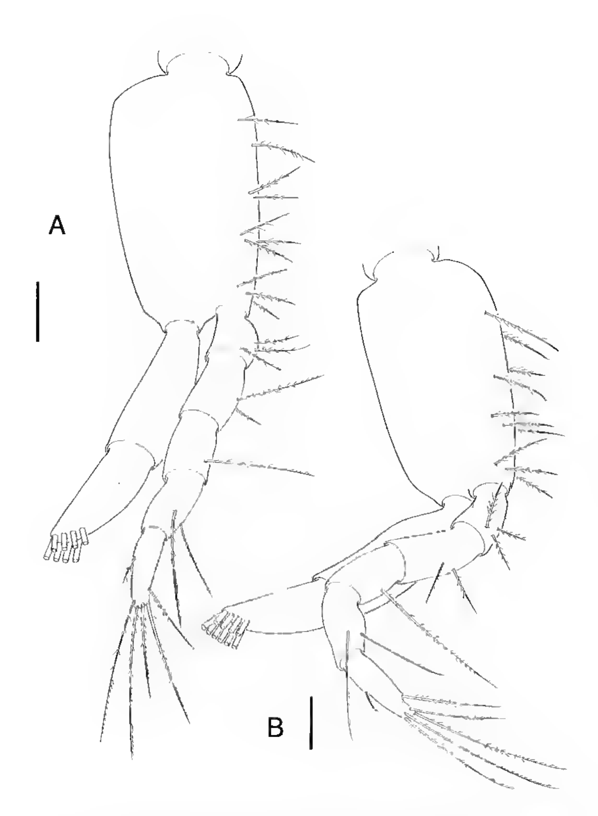
Pereiopods (Fig. 21C-G): all segments well differentiated and with setae; ischium of chela with prominent hook; ischium of walking legs 1-3 with a single spine; propodus of fifth pereiopod with three long subterminal setae.

Sternal plates: plates 1-3 fused with minute medial spine flanked with four pairs of setae; sternal plate 4 with a pair of minute medial spines and an outer pair of minute spines and with four pairs of setae; sternal plates 5 and 6 with one seta on each side; remaining sternal plates setae not observed but may be present.

Abdomen (Figs 17H, 20B, D, F, H, J, L): six somites present; somite 1 with three pairs of lateral setae, three medial setae and three pairs of posterior marginal setae; somites 2 and 3 with one pair of medial setae and five pairs of posterior marginal setae; somite 4 and 5 with two pairs of medial setae and five posterior marginal setae; somite 6 with two pairs of lateral setae; somites 2-5 each with one pair of biramous pleopods, endopod unsegmented with subterminal hooks on the internal margin; exopod unsegmented, pleopods 1-4 with 19, 20, 17, 15 long marginal plumose natatory setae respectively; uropod present on somite 6, biramous with an

Fig. 17. — *Lophozozymus pictor* (Fabricius, 1798): **A-C**, third maxilliped; **A**, third zoea; **B**, fourth zoea; **C**, megalop; **D**, **E**, maxillule; **D**, fourth zoea; **E**, megalop; **F**, maxilla of fourth zoea; **G**, **H**, dorsal view of abdomen; **G**, fourth zoea; **H**, megalop. Scale bars: A, B, 0.5 mm; C-H, 0.1 mm.


A
B
C
D
E
F
G
H



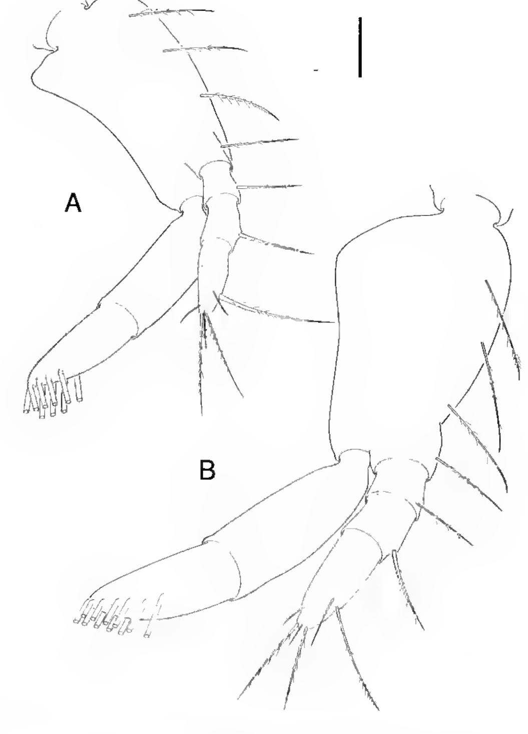


FIG. 18. — *Lophozozymus pictor* (Fabricius, 1798): first maxilliped; **A**, third zoea; **B**, fourth zoea. Scale bars: 0.1 mm.

FIG. 19. — *Lophozozymus pictor* (Fabricius, 1798): second maxilliped; **A**, third zoea; **B**, fourth zoea. Scale bar: 0.1 mm.

endopod seta, exopod with nine long marginal plumose natatory setae.

Telson (Figs 17H, 20B, N): with two pairs of medial dorsal and ventral setae, one of lateral setae, three posterior marginal setae (variable in number).

Palapedia valentini Ng, 1993
(Figs 22-25)

Palapedia valentini Ng, 1993: 145-147, fig. 5A-E.

REDESCRIPTION

Zoea I

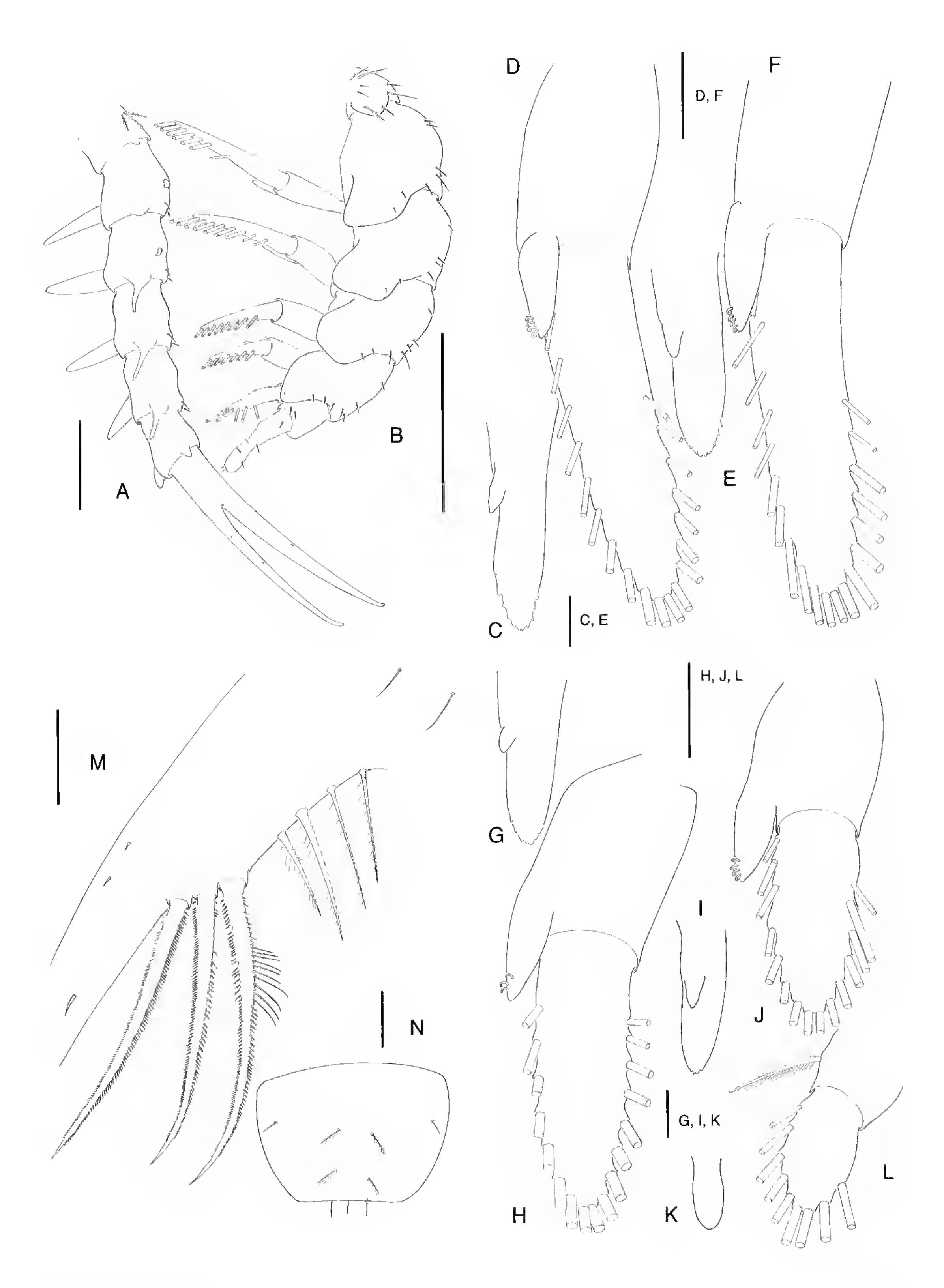
Carapace (Fig. 22A, E, F): dorsal spine long and curved distally with small tubercules, nearly twice as long as rostral spine; rostral spine much shorter than dorsal spine, approximately equal in length to the protopod of antenna, with a few small tubercules; lateral spines present and distally curved posteriorly; one pair of posterodorsal setae; ventral margin without setae; eyes sessile.

Antennule (Fig. 22B): uniramous, endopod absent; exopod unsegmented with two broad, long, two shorter, slender terminal aesthetascs and one terminal setae.

Antenna (Fig. 22C, D): protopodal process distally spinulate, approximately equal in length to rostral spine; endopod absent; exopod rudimentary, unsegmented with two unequal terminal setae.

Mandible: palp absent.

FIG. 20. — *Lophozozymus pictor* (Fabricius, 1798): **A**, **B**, lateral view of abdomen; **A**, fourth zoea; **B**, megalop; **C-F**, first pleopod, somite 2; **C**, fourth zoea; **D**, megalop, second pleopod, somite 3; **E**, fourth zoea; **F**, megalop, **G-L**, third pleopod, somite 4; **G**, fourth zoea; **H**, megalop, fifth pleopod, somite 5; **I**, fourth zoea; **J**, megalop, sixth pleopod (uropod), somite 6; **K**, fourth zoea; **L**, megalop; **M**, **N**, dorsal view of telson; **M**, fourth zoea; **N**, megalop. Scale bars: A, B, 0.5 mm; C-M, 0.1 mm.



A
B
C
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D, F
C, E
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H
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H, J, L
G, I, K

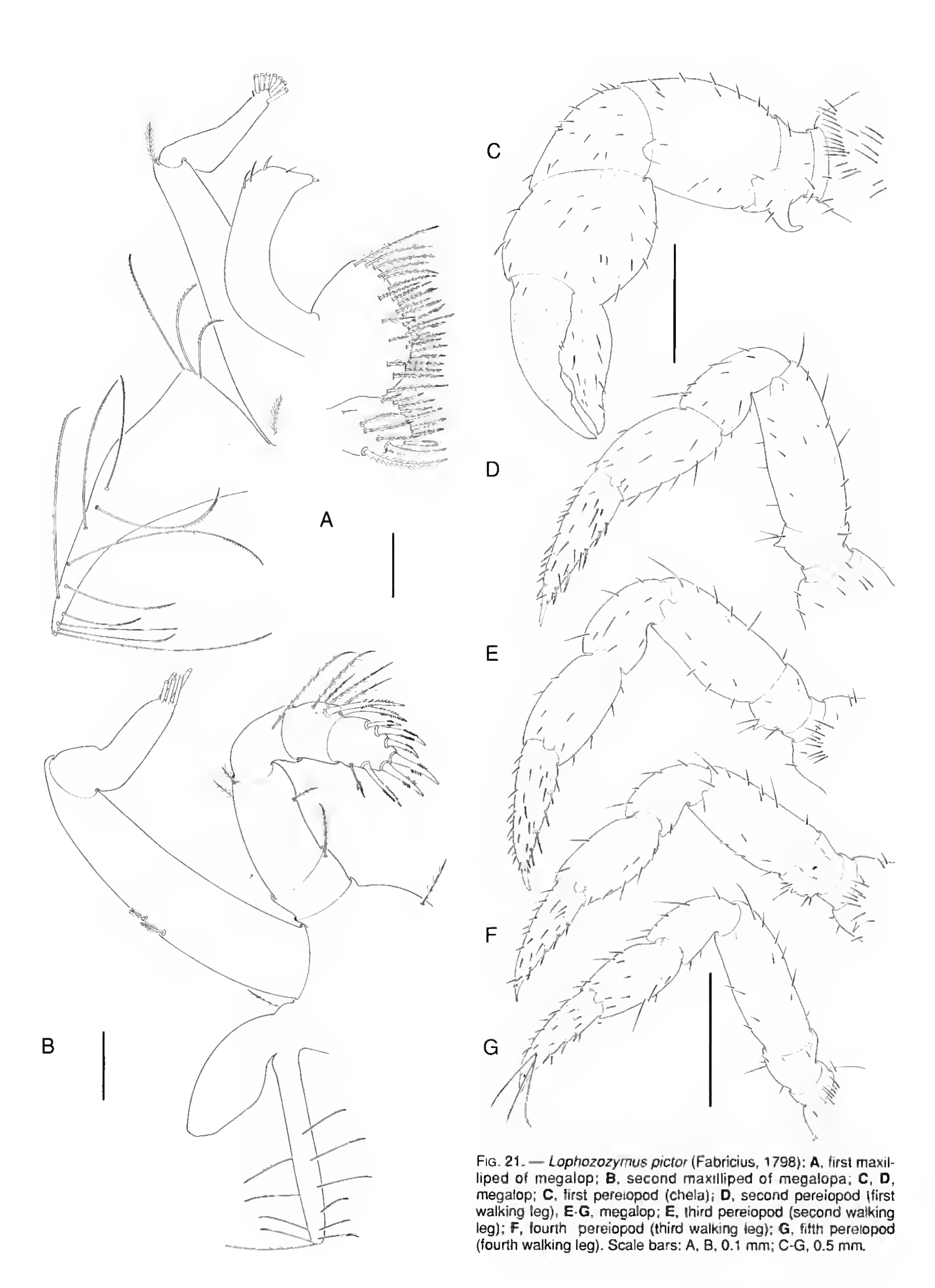


FIG. 21. — *Lophozozymus pictor* (Fabricius, 1798): **A**, first maxilliped of megalop; **B**, second maxilliped of megalopa; **C**, **D**, megalop; **C**, first pereiopod (chela); **D**, second pereiopod (first walking leg), **E**-**G**, megalop; **E**, third pereiopod (second walking leg); **F**, fourth pereiopod (third walking leg); **G**, fifth pereiopod (fourth walking leg). Scale bars: A, B, 0.1 mm; C-G, 0.5 mm.

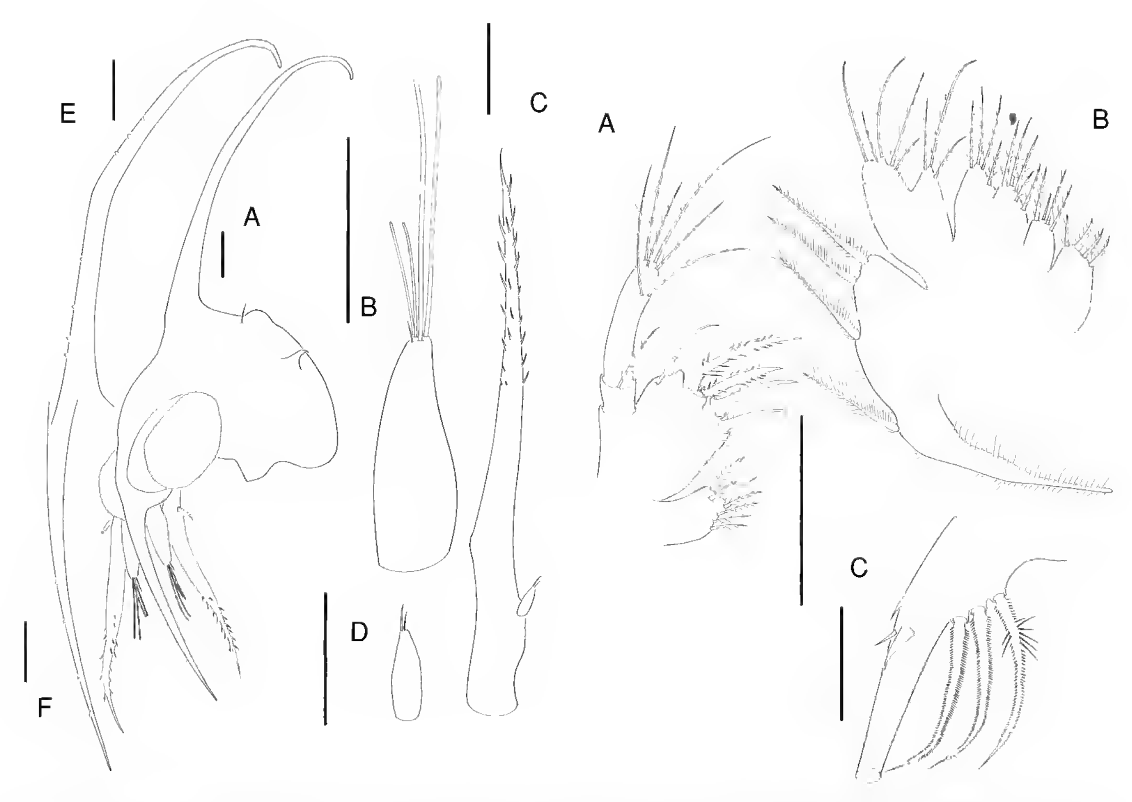


Fig. 22. — *Palapedia valentini* Ng, 1993: zoea I; **A**, lateral view of carapace; **B**, antennule; **C**, antenna; **D**, antennal exopod; **E**, dorsal spine; **F**, rostral spine. Scale bars: A-C, E, F, 0.1 mm; D, 0.05 mm.

Fig. 23. — *Palapedia valentini* Ng, 1993: zoea I; **A**, maxillule; **B**, maxilla; **C**, telson. Scale bars: 0.1 mm.

Maxillule (Fig. 23A): coxal endite with seven setae; basial endite with five setal processes and two small teeth; endopod 2-segmented, proximal segment with one seta; distal segment with six (two subterminal, four terminal) setae; exopod seta absent.

Maxilla (Fig. 23B): coxal endite bilobed with 4 + 4 setae; basial endite bilobed with 5 + 4 setae; endopod bilobed, with 3 + 5 (2 subterminal + 3 terminal) setae; exopod (scaphognathite) margin with four setae and one long distal stout process.

First maxilliped: (Fig. 24A) coxa without setae; basis with ten setae arranged 2, 2, 3, 3; endopod 5-segmented with 3, 2, 1, 2, 5 (1 subterminal + 4 terminal) setae respectively; exopod 2-segmented, distal segment with four long terminal plumose natatory setae.

Second maxilliped (Fig. 24B): coxa without setae; basis with four setae; endopod 3-segmented, with 1, 1, 6 (three subterminal and three terminal) setae respectively; exopod 2-segmented, distal segment with four long terminal plumose natatory setae.

Third maxilliped: absent.

Pereiopods: absent.

Abdomen (Fig. 25A, B): five somites; somite 2 with one pair of dorsolateral processes directed anteriorly; somite 3 with one pair of dorsolateral processes directed ventrally; somites 1-2 with rounded posterolateral processes and somites 3-5 with short posterolateral spinous processes; somite 1 without setae; somites 2-5 with one pair of posterodorsal setae; pleopod buds absent.

Telson (Figs 23C; 25A, B): each fork long, gradually curved distally; two minute lateral spines; large dorsal medial spine distally curved anteriorly, posterior margin with three pairs of stout spinulate setae.

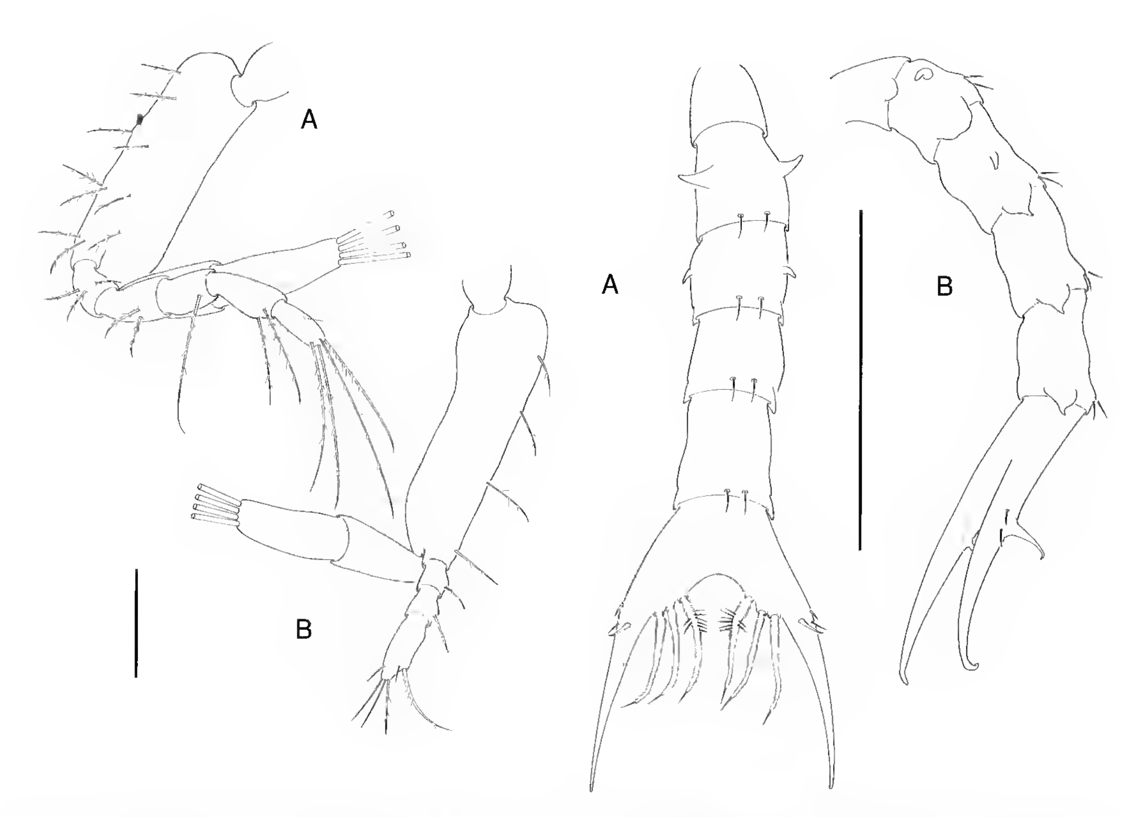


Fig. 24. — *Palapedia valentini* Ng, 1993: zoea I; **A**, first maxilliped; **B**, second maxilliped. Scale bar: 0.1 mm.

Fig. 25. — *Palapedia valentini* Ng, 1993: zoea I, abdomen; **A**, dorsal view; **B**, lateral view. Scale bar: 0.5 mm.

DISCUSSION

Serène (1984) listed seven genera, *Atergatopsis*, *Atergatis*, *Paratergatis*, *Zozymodes*, *Platypodia*, *Zosimus* and *Lophozozymus* assigned to the Zosiminae, but until now the only genus for which the zoeal development is known for this xanthid subfamily is *Atergatis* from the description by Terada (1980) of *A. reticulatus*. From his figures (1-3, D1-D4), Terada (1980) overlooked a number of characters described in this present study including dorsal carapace setation, setation of the ventral carapace margin, the mandibular palp and the third maxilliped. Nevertheless, a comparison between the four zoeal stages of *A. reticulatus* and *L. pictor* is useful (see Table 1). However, speculating on zoeal subfamilial characters from only these two accounts of this taxon would be misleading.

Of the twelve subfamilies now attributed to the Xanthidae MacLeay, 1838 *s.str.* (Serène 1984; Ng 1993; Ng & Chia 1994), the zoea of six are known and these include Chlorodiinae Alcock, 1898; Xanthinae MacLeay, 1838; Zosiminae Alcock, 1898; Actaeinae Alcock, 1898; Euxanthinae Alcock, 1898 and Kraussinae Ng, 1993. One first stage zoea that meets modern day descriptions was selected to represent each of these subfamilies, *Pilodius nigrocrinitus* by Terada (1982); *Xantho incisus* by Ingle (1991); *Lophozozymus pictor* from this present study; *Gaillardiellus orientalis* by Ng & Clark (1994); *Monodaeus couchi* by Ingle (1991) and *Palapedia valentini* by Ng (1993).
From the selected first zoea, only the endopod of the second maxilliped of *Monodaeus couchi* was re-examined because Ingle (1991: 235) described the distal segment of the endopod as "4 + 1

TABLE 1. — A list of characters that may separate the zoea of *Atergatis reticulatus* (from Terada 1980) and *Lophozozymus pictor* (from this present study).

	A. reticulatus	***L. pictor***
Antennule		
appearence of endopod	ZIV (fig. 2D4)	ZIII (Fig. 2C)
Antenna		
spinulation of protopod	present (fig. 2D'1-D'4)	absent (Fig. 8A, C, E, G)
Maxillule		
setation of coxal endite	ZII 7; ZIII 8 (fig. 2D"2, D"3)	ZII 8; ZIII 9 (Fig. 9B, C)
setation of basial endite	ZIII 9 (fig. 2D"3)	ZIII 11 (Fig. 9C)
Maxilla		
setation of coxal endite	ZIV 6 + 4 (fig. D'"4)	ZIV 5 + 4 (Fig. 21)
setation of basial endite	ZIV 6 + 7 (fig. D'"4)	ZIV 5 + 7 (Fig. 21)
Abdomen		
setation of somite 1	ZII 0; ZIII 0; ZIV 0 (fig. 3, D2-D4)	ZII 1; ZIII 3; ZIV 3 (Figs 13A, C; 22A)
Telson		
dorsal medial setation	ZIV 0 (fig. 3,D4)	ZIV 1 pair (Figs 22A; 26A)
posterior medial setation of posterior margin	ZII 0; ZIII 3; ZIV 4 (fig. 3, D2-D4)	ZII 2; ZIII 6; ZIV 8 (Figs 13B, C; 15B, C; 22A; 26A)

(sometimes 5 + 1) setae". The distal segment was confirmed as 5 + 1 setae or, as recorded in this study for *Lophozozymus pictor*, 3 subterminal + 3 terminal setae. The above first stage zoeas share the same chaetotaxy for the following appendages: maxillule, maxilla, first maxilliped, second maxilliped and the somites of the abdomen. Table 2 lists these appendages with a description of their chaetotaxy and segmentation. Used in combination, these characters may define the Xanthidae MacLeay, 1838 *s.str.* Zoeal features not shared by these species are the antennal morphology, configuration of carapace spines and setation and armature of the telson forks. It is these features that may provide characters for the Xanthidae at subfamilial level.

Recently Ng (1993) established a new Xanthidae subfamily, Kraussiinae. He described the first stage zoea for one of the species assigned to this new taxon, *Palapedia valentini* and suggested (Ng 1993: 149) that several peculiar zoeal features supported the establishment of a new subfamily. These characters included the setal formula of the first maxilliped basis and the first endopod segment of the first maxilliped. Two extant first stage zoea from the original study were dissected, the appendage characters reappraised, redescribed and figured in this present study. A number of zoeal characters were overlooked or misinterpreted by Ng (1993, fig. 5A) including absent dorsal carapace setation which are present (this study, Fig. 22A); absent (Ng 1993, fig. 5C) small terminal seta on the antennule which is present (this study, Fig. 22B); coxal setation of the maxilla with 5 + 2 (Ng 1993, fig. 5F) instead of 4 + 4 (this study, Fig. 23B); basial formula of the first maxilliped with 7 (2, 1, 2, 2) setae (Ng 1993, fig. 5H) instead of 10 (2, 2, 3, 3) (this study, Fig. 24A); first endopod segment setation of the first maxilliped with two setae (Ng 1993, fig. 5H) instead of three (this study, Fig. 24B); distal endopod segment setation of the second maxilliped with five (Ng 1993, fig. 5I) setae instead of six (this study, Fig. 24B) and the lateral processes on abdominal somites 1, 2 (Ng 1993, fig. 5K) instead of somites 2, 3 (this

TABLE 2. — A list of first stage zoeal characters that, used in combination, may define the Xanthidae MacLeay, 1838.

Carapace	1 pair of posterodorsal setae ventral carapace margin devoid of spines
Antennule	uniramous, endopod absent
Mandible	palp absent
Maxillule	coxal endite with 7 setae basial endite with 5 setal processes and 2 small teeth endopod 2-segmented, proximal segment with 1 seta distal segment with 5 (2 subterminal, 4 terminal) setae exopod seta absent
Maxilla	coxal endite bilobed with 4 + 4 setae basial endite bilobed with 5 + 4 setae endopod bilobed, with 3 + 5 (2 subterminal and 3 terminal) setae exopod (scaphognathite) margin with four setae and one long distal stout process
First maxilliped	basis with 10 setae arranged 2, 2, 3, 3 endopod 5-segmented with 3, 2, 1, 2, 5 (1 subterminal and 4 terminal) setae respectively exopod 2-segmented, distal segment with four long terminal plumose natatory setae
Second maxilliped	basis with 4 setae endopod 3-segmented, with 1, 1, 6 (3 subterminal and 3 terminal) setae respectively exopod 2-segmented, distal segment with 4 long terminal plumose natatory setae
Third maxilliped	absent
Pereiopods	absent
Abdomen	5 somites somite 2 with 1 pair of lateral processes directed anteriorly somite 3 with 1 pair of lateral processes directed posteriorly somites 2-5 with 1 pair of posterodorsal setae pleopod buds absent
Telson	posterior margin with 3 pairs of stout spinulate setae

study Fig. 25A, B). In fact the setal armature of *Palapedia valentini*, especially with respect to the chaetotaxy of the first maxilliped, does not differ from other Xanthidae as listed in table 2.

Martin (1984, fig. 1) figured features for six groups of xanthid zoeas and the first stage zoeal appendages of *Palapedia valentini* agree with all eight characters defining his group I which include (Martin 1984: 221): (1) dorsal, rostral and carapace spines all well-developed; (2) the rostral spine and the antennal protopod are approximately equal in length; (3) a reduced exopod with two short terminal setae; (4) two subterminal and four terminal setae on the distal segment of the maxillule endopod; (5) eight setae on the endopod of the maxilla; (6) basal endopod segment of first maxilliped with three setae; (7) basal endopod segment of second maxilliped with a single seta; and (8) dorsolateral knobs (spines) on abdominal segments (somites) 1 and 2. *Lophozozymus pictor* first stage zoea conform to seven of Martin's eight group I characters. However, the definition by Martin (1984) of the antennal exopod character for his xanthid group I, "Antennal exopod reduced [...] never armed with more than two short terminal setae", is ambiguous. *Lophozozymus pictor* possesses one long subterminal seta in addition to the two

short terminal setae and therefore it is unclear whether this species would be placed by Martin in his xanthid group I.

Rice (1980: 325) recognized three types of xanthid antennal exopod: (1) a rudimentary exopod with one or two terminal setae or unarmed; (2) an exopod subequal to or longer than spinous process and with a seta more or less midway along its length and (3) an exopod one third-one quarter the length of the spinous process with two or three terminal setae. The antennal exopod of *Palapedia valentini* conforms to definition (1), however, that of *Lophozozymus pictor* cannot be assigned to any of the xanthid criteria defined by Rice.

Current evidence suggests that the antennal exopod is not a zoeal character to define the Xanthidae MacLeay, 1838 (*sensu* Serène 1984) and its significance at subfamilial level remains unclear. The presence of two terminal setae on the antennal exopod is of interest, but the importance of this zoeal character within the Kraussiinae Ng, 1993, has yet to be established.

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The authors considered working in the attic of the Laboratoire de Zoologie (Arthropodes) with Alain Crosnier a rare privilege. We thank Alain for much support, encouragement and humour. We would also like to thank Diana Chia for assistance in collecting and patiently rearing the zoeas of *Lophozozymus pictus* through to megalop phase. Peter Ng acknowledges grant RP900360 from the National University of Singapore.

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A new species of *Intesius* (Crustacea, Decapoda, Goneplacidae) from the deep water of French Polynesia

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Davie P. J. F.1998. — A new species of *Intesius* (Crustacea, Decapoda, Goneplacidae) from the deep water of French Polynesia. *Zoosystema* 20 (2) : 221-227.

KEY WORDS
Crustacea,
Decapoda,
Brachyura,
Intesius,
deep water,
Pacific Ocean,
new species.

ABSTRACT
A new species of the previously monotypic genus *Intesius*, *I. crosnieri*, is described from 500 m depth in French Polynesia. New records of *I. pilosus* Guinot *et* Richer de Forges, 1981 are also recorded from off north Queensland, Australia. The two species can be easily separated by the shape of the carapace and anterolateral teeth. Figures are provided of both species.

MOTS CLÉS
Crustacea,
Decapoda,
Brachyura,
Intesius,
eaux profondes,
océan Pacifique,
nouvelle espèce.

RÉSUMÉ
Une nouvelle espèce du genre Intesius *(Crustacea, Decapoda, Goneplacidae) des eaux profondes de Polynésie française. Intesius crosnieri*, une nouvelle espèce du genre *Intesius*, considéré jusqu'à présent comme monotypique, est décrite de Polynésie française par 500 m de profondeur. *Intesius pilosus* Guinot *et* Richer de Forges, 1981 est également signalée du nord du Queensland, en Australie. Les deux espèces se distinguent facilement par la forme de la carapace et les dents antérolatérales.

INTRODUCTION

The specimen, for which the new species is described, was sent to me for study by Joseph Poupin of the French Service Mixte de Contrôle Biologique (SMCB). It had already been examined by Dr Alain Crosnier, and recognized as probably new to science.
Intesius Guinot *et* Richer de Forges, 1981, has until now been considered monotypic, including only *I. pilosus* Guinot *et* Richer de Forges, 1981. It was placed into the Goneplacidae but the relationships within the family have not been further clarified... "*La position taxonomique d'*Intesius pilosus *n.sp. sera précisée ultérieurement*" (Guinot & Richer de Forges 1981b: 256).

ABBREVIATIONS

mm	millimetres;
G1, G2	first and second male gonopods;
MNHN	Muséum national d'Histoire naturelle, Paris;
QM	Queensland Museum, Brisbane.

The abbreviated terminology used for carapace regions is that used by Serène (1984) following Dana (1852).
Measurements given in the text are of carapace breadth (c.b.) followed by length.

SYSTEMATICS

Family GONEPLACIDAE MacLeay, 1838
Intesius crosnieri n.sp.
(Figs 1A, 2A, 3, 4)

MATERIAL EXAMINED. — **French Polynesia**. Îles sous le vent, Maiao, stn 173, 17°38.4'S - 150°38.8'W, trapped, 500 m, 1996, SMCB (J. Poupin): holotype, ♂ 46.4 × 39.8 mm (MNHN-B25374).

ETYMOLOGY. — The species is dedicated to Alain Crosnier in recognition of his enormous generosity in allowing, and assisting me to study not just this new crab but the large fascinating collections of deep water xanthid species from French Polynesia and New Caledonia that I have previously reported on (Davie 1993; 1997).

DISTRIBUTION. — Only known from the type locality. Bathymetric range: 500 m.

DESCRIPTION

Carapace
ca. 1.2 times broader than long; moderately convex anteriorly, slightly convex from side to side across the posterobranchials. Regions moderately well defined, separated by broad furrows, except 1F/2F, 2L/3L, 5L/6L are not distinctly separated. Posterior margin costate, with a raised finely granular rim; posterolateral margins more or less straight, converging posteriorly. Anterolateral margins regularly convex, granular, with four teeth behind the exorbital angle; first and fourth teeth small, first well-separated from orbit, indistinct, little more than a raised granule; second and third teeth subequal, acute, with sharp granules on the margins; fourth teeth situated well back and in the form of a small spine; greatest carapace width across third teeth. Front *ca.* 0.28 times carapace width; square-cut, bilobed, moderately projecting, narrow band of sharp granules behind leading edge; separated from orbit by a narrow, smooth, pre-orbital sulcus. Carapace surface covered with small granules diminishing in size towards the inter-regional furrows; thickly clothed with fine simple setae which do not obscure the surface detail. Upper orbital border concave, granular; a small spine separating deep median and lateral fissures. Lower orbital border inner angle formed by large triangular, bluntly pointed tooth; laterally with a second smaller blunt granular lobe; with V-shaped notch laterally. Antennal flagellum entering orbit, fine, long, reaching as far as second anterolateral tooth. Basal antennal segment widely separated from front, rectangular, unarmed. Basal antennular segment finely granular, with shaggy coat of short setae; palp folding obliquely.

Third maxilliped
Merus slightly swollen on medial surface, microscopically granular only; about as wide as long and about half length of ischium; antero-external angle slightly produced, rounded. Ischium elongate, sub-rectangular *ca.* 1.95 times longer than wide.

Chelipeds
Unequal; large and robust; minor cheliped of



FIG. 1. — **A**, *Intesius crosnieri* n.sp., holotype ♂ 46.4 × 39.8 mm (MNHN-B25374), French Polynesia, Îles sous le vent, Maiao, 17°38.4'S - 150°38.8'W, trapped, 500 m, 1996; **B**, *Intesius pilosus* Guinot *et* Richer de Forges, 1981, ♀ 40.8 × 36.9 mm (QMW17026), northern Queensland, off Tully Heads, 17°59.6'S - 147°01.8'E, trawled 220 m, 12.I.1986.

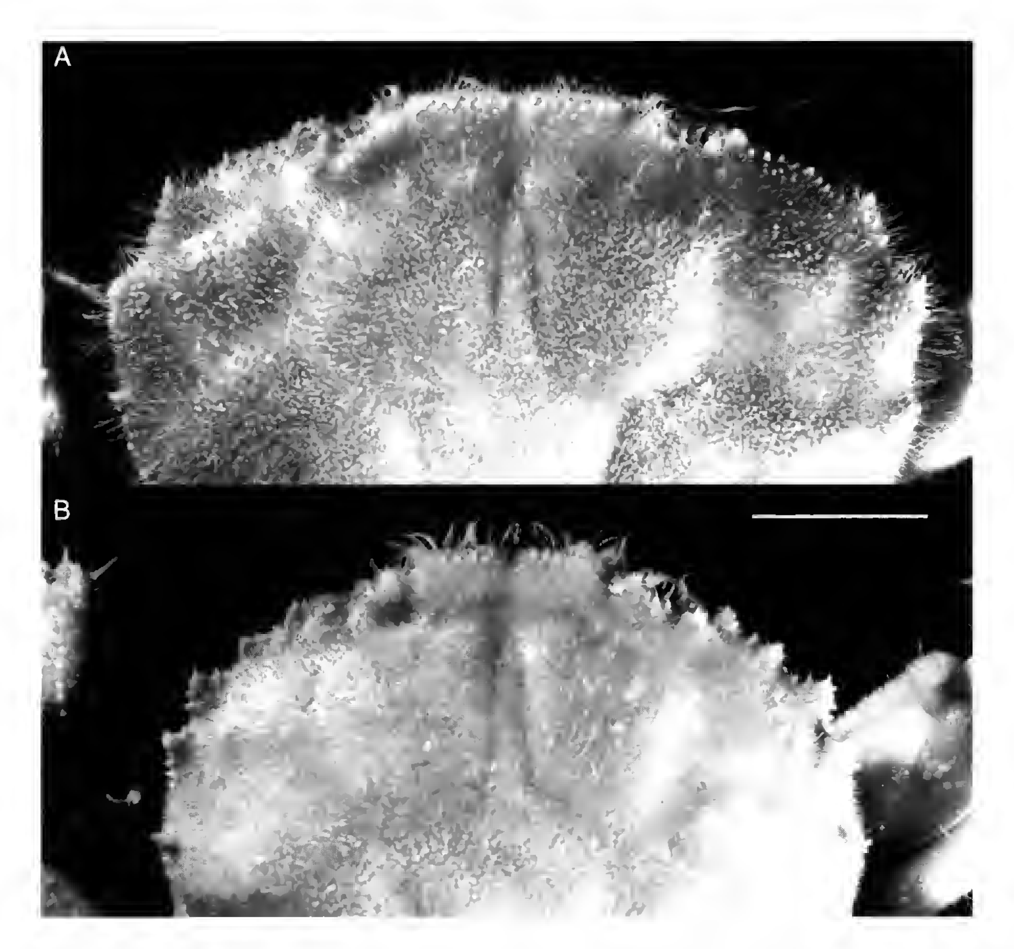


FIG. 2. — Magnified view of anterior carapace; **A**, *Intesius crosnieri* n.sp., holotype ♂ (MNHN-B25374); B, *Intesius pilosus* Guinot *et* Richer de Forges, 1981, ♀ (QMW17026). Scale bar: 1 cm.

similar form but with longer more slender fingers. Merus trihedral, short and broad, posterior border with sharp spinules, with slightly larger spine on edge of subdistal shoulder, distally rounded and unarmed. Carpus with strong spine at inner angle, ventrally unarmed; upper and outer surfaces with small sharp granules. Outer surface of palm of large chela covered in sharp granules dorsally and proximally, becoming microscopically granular ventro-distally; with only minute setae between the granules dorsally; minor chela with sharp granules evenly and entirely covering outer surface. Fixed finger with ventral ridge, and second longitudinal groove below cutting margin; length cutting edge *ca.* 0.38 times length propodus. Ventral border of chela slightly concave at base of fixed finger. Dorsal surface of dactylus microscopically granular; dactylus broad, bearing three longitudinal grooves on outer face, running most of length. Fingers pointed, recurved; cutting margins of both fingers with low molariform teeth. Fingers entirely black except for base of dactyl, colour not extending backwards onto palm.

Walking legs

Medium length; compressed; relatively stout; second pair the longest *ca.* 1.7 times maximum carapace width. Merus of third leg *ca.* 4.2 times longer than wide; carpus *ca.* 2.7 times longer



Fig. 3. — Ventral view of *Intesius crosnieri* n.sp., holotype ♂ 46.4 × 39.8 mm (MNHN-B25374), French Polynesia, Îles sous le vent, Maiao, 17°38.4'S - 150°38.8'W, trapped. 500 m, 1996.

than wide; propodus *ca.* 2.65 times longer than wide; dactylus *ca.* 1.35 times length of propodus. Dactyli thick, straight, compressed; terminating in an acute chitinous tip. All leg segments unarmed, more or less minutely granular on upper margins; marginally fringed with setae, becoming thicker and having a more extensive coverage distally.

Male abdomen

Third to fifth segments fused; third segment the widest. Segments 3-5 tapering. Segment 6, 1.8 times wider than long. Telson slightly longer than, and moderately sunken into, segment 6; 1.36 times wider than long; evenly rounded.

Gonopods

G1 short and stout, generally tapering, a pre-distal shoulder bearing a patch of short stout bristles. G2 similar in length, filament occupying distal third (see Fig. 4B-D).

Sternum

Relatively broad, finely granular and hirsute; broad shallow depression in front of telson; suture between segments 3 and 4 incised laterally, becoming shallow and indistinct medially.

Remarks

Intesius pilosus Guinot *et* Richer de Forges, 1981, was described from a single holotype specimen. Subsequently Davie & Short (1989) recorded a single female from 183 m depth off southern Queensland.. Further specimens from Queensland have been since found, and have provided valuable comparative material for understanding the limits of variation in that species, and helped to clearly distinguish the present new species.

The carapace provides the most important characters useful in separating the two species. *I. pilosus* is subcircular in shape, whereas *I. crosnieri* has a more quadrate appearance caused by the more convex anterolateral margins. The greatest carapace width is between the third anterolateral teeth, whereas in *I. pilosus* the fourth anterolateral teeth are either as prominent, or more prominent, than the third. The anterolateral teeth of *I. pilosus* are generally more projecting and acute than in *I. crosnieri*, and the accessory spinules on their margins are also more prominent and acute. In particular, the first anterolateral tooth in *I. crosnieri* is almost obsolete, but is a clearly differentiated, strong, spinulose tooth in *I. pilosus*.

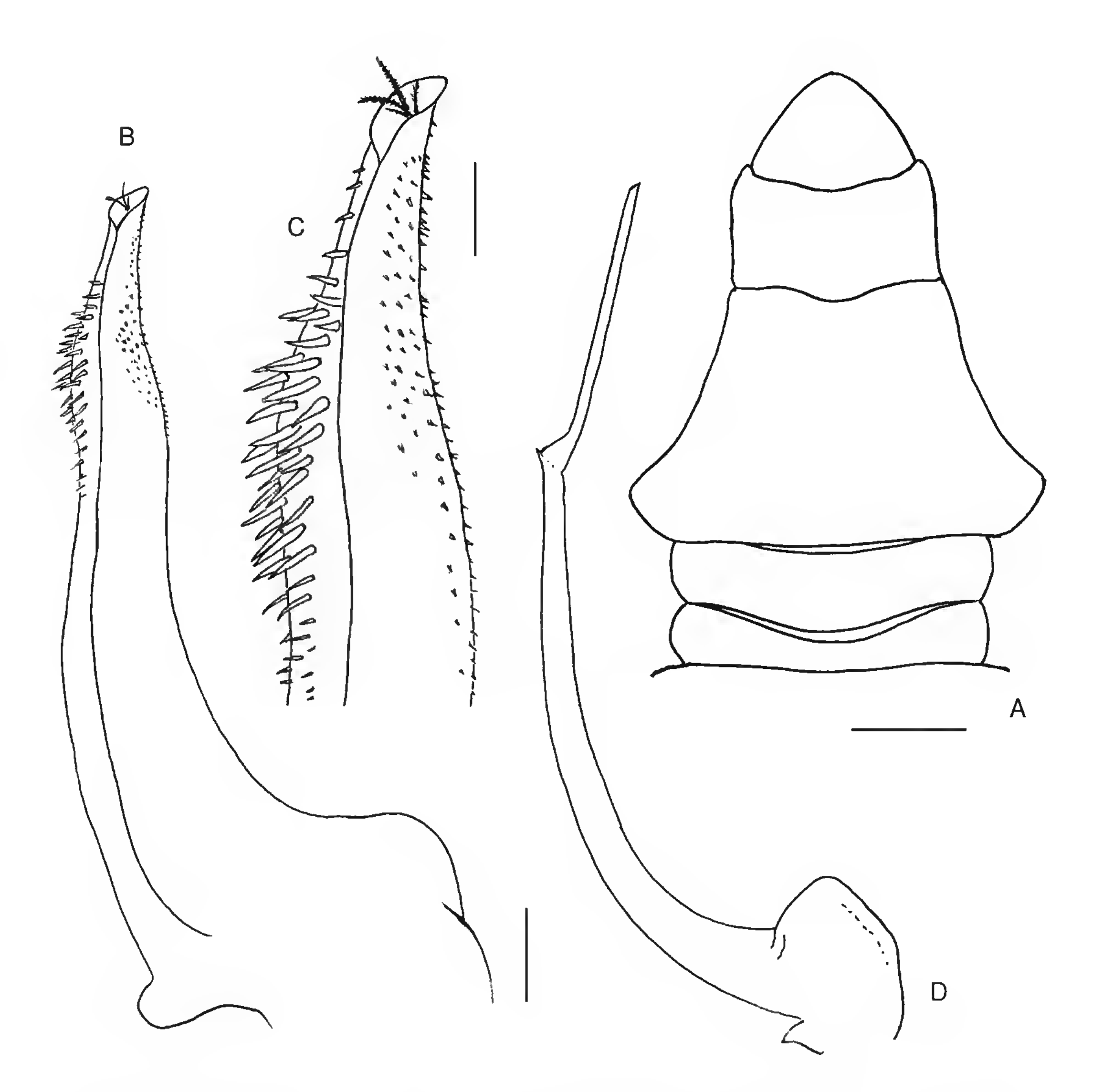


FIG. 4. — *Intesius crosnieri* n.sp., holotype ♂ 46.4 × 39.8 mm (MNHN-B25374); **A**, abdomen; **B**, **C**, gonopod 1; **D**, G2. Scale bars: A, 5 mm; B, D, 1 mm; C, 0.5 mm.

The gonopods of the two species are very close, but *I. crosnieri* has a slightly broader more flared tip, which has several setae projecting from it, and these are absent in *I. pilosus*.

Intesius pilosus has been recorded from depths of 183-400 m, whereas *I. crosnieri* is from 500 m depth. It remains to be seen whether or not this indicates different bathymetric depth preferences, which would be of significance if they are found to occur sympatrically in the future.

Intesius pilosus
Guinot *et* Richer de Forges, 1981
(Figs 1B, 2B)

Intesius pilosus Guinot *et* Richer de Forges, 1981a: pl. 7, 1, 1a, 1b; 1981b: 253-6, figs 6D, 11A-G. – Davie & Short 1989: 184-5.

MATERIAL EXAMINED. — **Northern Queensland.** Off Tully Heads, RV *Soela* (CSIRO), 17°59.2'S - 147°03.1'E, trawled 260 m, 13.I.1986: ♀ 26.2 ×

23.8 mm, ♂ 35.0 × 32.0 mm (QM-W17024). — 17°59.6'S - 147°05.5'E, trawled 260 m, 19.I.1986: 2 ♀♀ 27.5 × 25.8 mm, 27.0 × 25.1 mm (QM-W17025). — 17°59.6'S - 147°01.8'E, trawled 220 m, 12.I.1986: ♀ 40.8 × 36.9 mm (QM-W17026). — 18°00.1'S - 147°01.3'E, trawled 228 m, 09.I.1986: ♂ 39.0 × 36.2 mm (QM-W17027).

DISTRIBUTION. — Loyalty Islands (type locality), and Coral Sea off eastern Queensland to 27°S latitude. Bathymetric range: 183-400 m.

REMARKS

The present series of specimens are very consistent in morphology, and agree closely with the description and figures of the holotype. There is variation in the prominence of the last anterolateral tooth, such that it may be equal in prominence to the third or slightly more projecting.

Acknowledgements

I am most grateful to Joseph Poupin for asking me to undertake this study; and to Bertrand Richer de Forges and Enrique Macpherson for inviting me to contribute to this special volume honouring Alain Crosnier.

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A new genus and a new species of alpheid shrimp (Decapoda, Caridea) from Japan

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KEY WORDS
Crustacea,
Decapoda,
Alpheidae,
Cavipelta,
new genus,
new species,
Pacific Ocean.

ABSTRACT
A new genus of the family Alpheidae is established, based on a new species from Japanese waters. *Cavipelta yamashitai* n.g., n.sp. is characterized by having a sinus on the lower margin of the carapace in both sexes and a flap-like process on the exopod of the uropod in large males. It also bears a robust and thickened antennal flagellum and a mesially curved chela of the first pereopod in large males. *C. yamashitai* was usually collected from burrowes of thalassinids. The systematic position of the new genus is discussed and the biology of the new species is briefly presented.

MOTS CLÉS
Crustacea,
Decapoda,
Alpheidae,
Cavipelta,
nouveau genre,
nouvelle espèce,
océan Pacifique.

RÉSUMÉ
Un nouveau genre et une nouvelle espèce de crevette alphéide (Decapoda, Caridea) provenant du Japon. Cavipelta yamashitai n.g., n.sp. est caractérisée par la présence d'un sinus sur le bord inférieur de la carapace dans les deux sexes et d'un appendice foliacé sur l'exopodite de l'uropode chez les grands mâles. Elle porte également un flagelle antennaire robuste et épaissi et la pince du premier péréiopode est courbée en son milieu chez les grands mâles. *C. yamashitai* est généralement récoltée dans les rerriers de thalassinides. La position sysrématique de ce nouveau genre est discutée ainsi que la biologie de cette nouvelle espèce.

INTRODUCTION

During studies on the shrimp fauna of the Seto Inland Sea, Japan, Yamashita (1980) collected a small alpheid from burrow of *Upogebia major* (De Haan). He tentatively identified it with *Athanas* sp. and briefly presented its ecological notes. Fortunately I could examine a part of his material, and later I received other specimens of the same species collected from the tidal flat of several localities of southern Japan. As roughly illustrated in Yamashita (1980), this species is readily distinguished from all the known species of *Athanas* by having a rounded sinus at the middle of the lower margin of carapace and rounded pectinations on the diaeresis of the outer uropod. These features are possibly unique in the family Alpheidae and even in the section Caridea, and for this reason the new genus, *Cavipelta*, is defined for the species, *C. yamashitai* n.sp.

All specimens have been deposited in the collection of the National Fisheries University (NFU). The specimen size is indicated by the carapace length (CL) including the rostrum.

Family ALPHEIDAE Rafinesque, 1815
Cavipelta n.g.

TYPE SPECIES. — *Cavipelta yamashitai* n.sp.

ETYMOLOGY. — The name is derived from the Latin *cavus*, meaning hollow, and *pelta* meaning shield, in reference to the fact that the lower margin of the carapace is apparently hollowed in the species of this genus. The gender is feminine.

DIAGNOSIS

Small alpheid, about 25 mm in body length. Rostrum short, acute; carapace smooth, without carina or spine but with rounded insertion at middle of lower margin; cardiac notch well-developed. Abdomen smooth without carinae or spines. Triangular flap articulated at posterolateral angle of sixth somite. Telson with two pairs of dorsal spines; posterior margin not terminating in triangular tooth, with two pairs of spines laterally. Anal tubercle absent.

Eyes largely exposed from dorsal view. Antennular peduncle long; stylocerite triangular, well developed. Antennal peduncle robust, with scaphocerite reduced; flagellum robust and long. Mandible with molar process and 2-jointed palp articulated with base of incisor process. Palp of first maxilliped 2-segmented. Second maxilliped without podobranch. Third maxilliped with arthrobranch; coxa with both strap-like epipod and flattened process. Exopods on first to third maxilliped well-developed. First pereopods moderately robust, similar and equal, carried extended; fingers lacking molar tooth and fossa. Second pereopod slender with 5-segmented carpus. First three pereopods with strap-like epipod. Uropod with long and articulated flap on distal end of exopod in large males but without in females; diaeresis of exopod with series of rounded lobes in both sexes. Appendix masculina longer than appendix interna but not overreaching endopod of second pleopod.

Gill formula as follows:

	Maxilliped			Pereopod				
	1	2	3	1	2	3	4	5
Pleurobranch	-	-	-	1	1	1	1	1
Arthrobranch	-	-	1	-	-	-	-	-
Podobranch	-	-	-	-	-	-	-	-
Mastigobranch	-	-	-	1	1	1	1	-
Epipod	1	1	1	1	1	1	-	-
Exopod	1	1	1	-	-	-	-	-

SYSTEMATIC POSITION

Cavipelta probably belongs to the primitive group of the family Alpheidae, characterized by having a short rostrum, dorsally exposed eyes, articulated plate of sixth abdominal somite, no sound-producing mechanism on the first pereopods, serrated diaeresis of the exopod of uropod and pereopodal epipods. *Potamalpheops* Powell, 1979 and *Pseudoathanas* Bruce, 1983 share these characters with the new genus. However, *Cavipelta* is unique among the family in bearing a sinus on the lower margin of the carapace in both sexes, and having flap-like processes on the exopod of the uropod in adult males. These features are apparently uncommon in the family, and even in the Caridea, although some similar features are observed in a few groups.

The anterolateral angle of the carapace is fairly excavated in some genera of the family Pasiphaeidae (Holthuis 1993). In *Cavipelta* the central part of the lower margin of the carapace, at about the level of the base of the first or second pereopods, is sinuous. This sinus is developed in large specimens of both sexes, and less in small specimens.

Some specified features of the uropods are observed in other alpheids. The serrated diaeresis appears in some alpheids; many movable spines in *Pseudoathanas* (Bruce 1983) and some immovable spines in *Potamalpheops* (Powell 1979) and *Prionalpheus* (Banner & Banner 1960). There are some species of other alpheid genera with one or two spines or spiniform processes on the diaeresis (Crosnier & Forest 1966; Miya 1972; Hayashi 1996). However, in these genera the spines are more or less pointed, whereas in serrated lobes of *Cavipelta* they are immovable and large with rounded apex.

The extended uropodal exopod is not known in other alpheids. *Mohocaris bayeri* Holthuis, 1973 bears an extremely long and slender process on the uropod, but it is on the endopod (Holthuis 1973). *Racilius compressus* Paulson, 1875 has a large spine other than the outer distal one on the exopod of the uropod, but it is also on the endopod (Paulson 1875; Bruce 1985; Hayashi 1995). In contrast *Cavipelta* has a slender and elongated flap on the outer uropod. This flap is articulated with more than two segments. This character is seen in the large males only, and is entirely absent in small males as well as in ovigerous females in which the outer margin of the exopod is largely rounded as in other members of the family.

The uropodal serration is the best character to distinguish *Cavipelta* from the related genera, even in small individuals or female specimens which do not have a differentiated uropodal flap and the carapacial sinus.

Cavipelta also bears other features uncommon in other alpheids, such as a robust and thickened antennal flagellum, and a mesially curved chela of the first pereopod in large males. The antennal flagellum, which is larger in males than in females, is rigid, strengthened proximally and curved upward. The first pereopods are similar and usually set in the extended position. The chela is sexually dissimilar. In large males it is curved mesially; the immovable finger is curved at a right angle or more than 90° to the palm. The movable finger, therefore, is situated perpendicularly at the distal end of the major part of the leg. In females and small males the chela is not modified, the finger is situated at a distolateral position.

The gill formula of *Cavipelta* is different from that of the related genera, *Pseudoathanas* and *Potamalpheops*. An arthrobranch is present on the base of the third maxilliped in *Cavipelta* and *Potamalpheops* (Powell 1979), but absent in *Pseudoathanas* (Bruce 1983). A strap-like epipod is present on the third maxilliped and the first four pereopods in *Potamalpheops* (Powell 1979), but on the first three pereopods only in *Pseudoathanas*. In the latter genus, there is no strap-like epipod on the third maxilliped, only a flattened process (Bruce 1983). In *Cavipelta* the strap-like epipod is present on first three pereopods and on the third maxilliped, and a flattened and anteriorly pointed process is also present.

Cavipelta yamashitai n.sp.
(Figs 1-4)

Athanas sp. – Yamashita, 1980: 6, unnumbered fig.

Material examined. — **Seto Inland Sea.** Tidal flat, off Miyajima, Hiroshima Prefecture, living in tube of Upogebia major, 4.VIII.1980, Coll. K. Yamashita: 1 ♂, holotype (NFU No. 530-2-1877). — 13.II.1990, Coll. K. Yamashita: 10 ♂♂, 3 ovig. ♂, 3 ♀♀, paratypes (NFU No. 530-2-1878). — Tidal flat, off Kutanabe Shrine, Hirao, Yamaguchi Prefecture, Coll, M. Kamiichi: 1 ♂, paratype (NFU No. 530-2-1879). — Tidal flat, Toyo Port, Ehime Prefecture, 12.V.1995, Coll. Y. Ide: 1 ♂, 1 ♀, 2 juveniles, paratypes (NFU No. 530-2-1880).
Southern Sea of Japan. Mouth of Matsumoto River, off Hagi, Yamaguchi Prefecture, dredge sample, VIII.1984, Coll. M. Amio: 1 ovig. ♀, 1 juv., paratypes (NFU No. 530-2-1881).

Etymology. — The specific name is dedicated to Mr. Kinji Yamashita, of the Miyajima Aquarium, who collected this species and called attention to it more than fifteen years ago.

Size. — The holotype, a complete male 6.8 mm CL. The males with a flap-like process on the exopod of

the uropod are more than 6.0 mm CL, and the largest male is 7.6 mm CL. The ovigerous females are nearly equal to males in size, 4.6-7.2 mm CL. A female of 6.8 mm CL bears about 100 eggs and their diameter is 0.5-0.6 × 0.42-0.47 mm. The egg number and egg size of the other three females are similar to those of this female.

DESCRIPTION

Small alpheid with slender and smooth body (Fig. 1). Rostrum short triangular in dorsal view, reaching only to base of eye, with short mid-dorsal crest in larger specimens (Fig. 2A, B). Carapace smooth, without spines on anterior margin (Fig. 2C); cardiac notch deep; lower margin with well-developed sinus at position of base of first or second pereopod (Figs 2B, 4B, C).

Abdomen smooth without carinae or spines. First pleuron sometimes with small indentation just above anterolateral corner (Fig. 4C). Pleura of fifth somite pointed but not sharp. Posterior process of sixth somite with small spine on upper distal end; articulated plate large and triangular (Figs 2D, 4H-J). Telson with two pairs of large spines, anterior pair at proximal fourth and posterior pair at middle (Figs 2D, 4H-J); posterior margin largely rounded with two pairs of spines laterally short outer and long inner.

Eyes exposed dorsally and laterally, with small anteromesial process (Fig. 2A-C); cornea well-pigmented, oval in outline in dorsal view (Fig. 2L). Antennule long and slender; stylocerite triangular, acute, reaching end of proximal one third of first segment; second segment 1.5 times as long as first; third segment much shorter than first (Fig. 2A, B, L); outer flagellum as long as peduncle, and thickened at several basal joints; inner flagellum slightly longer than peduncle with short setae on proximal half (Fig. 2L). Antennal peduncle more robust in males than in females, overreaching scaphocerite and antennular peduncle; scaphocerite comparatively small,

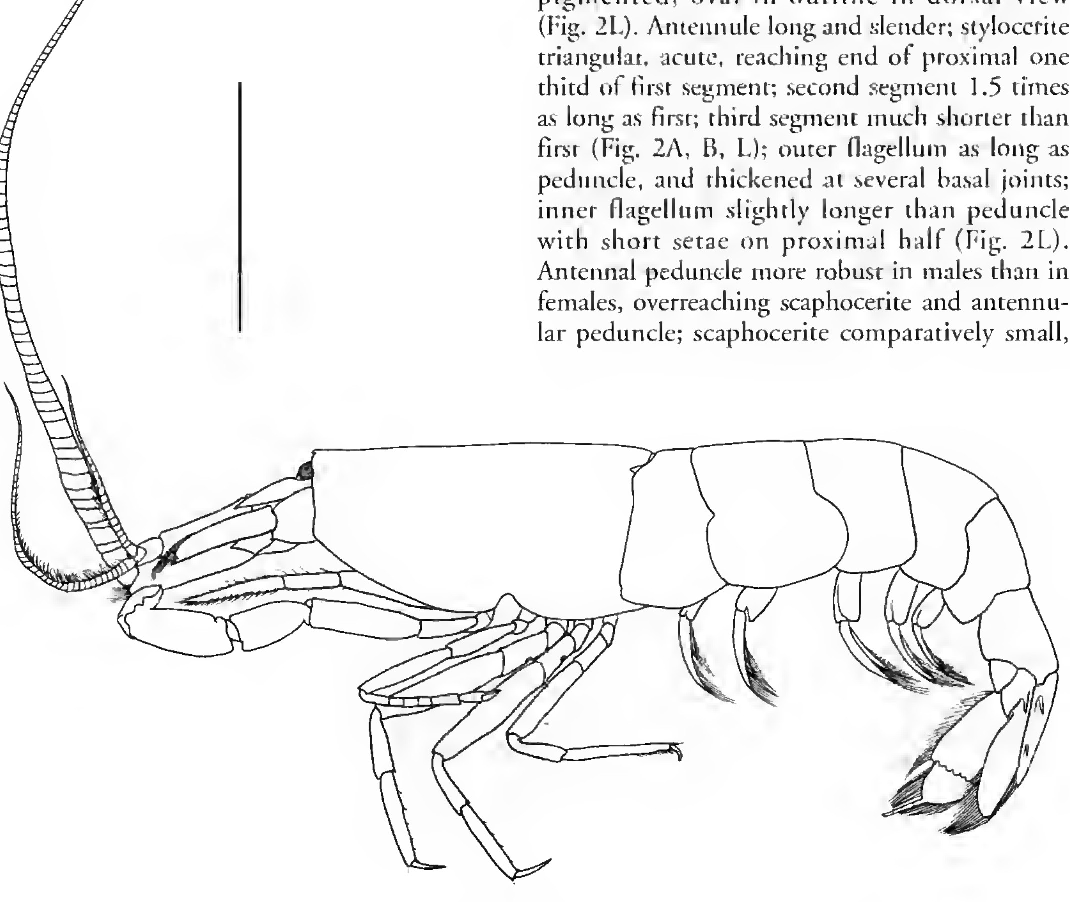


FIG. 1. — *Cavipelta yamashitai* n.sp., holotype, ♂ from Miyajima Island, 7.3 mm CL (NFU No. 530-2-1877). Scale bar: 5.0 mm.

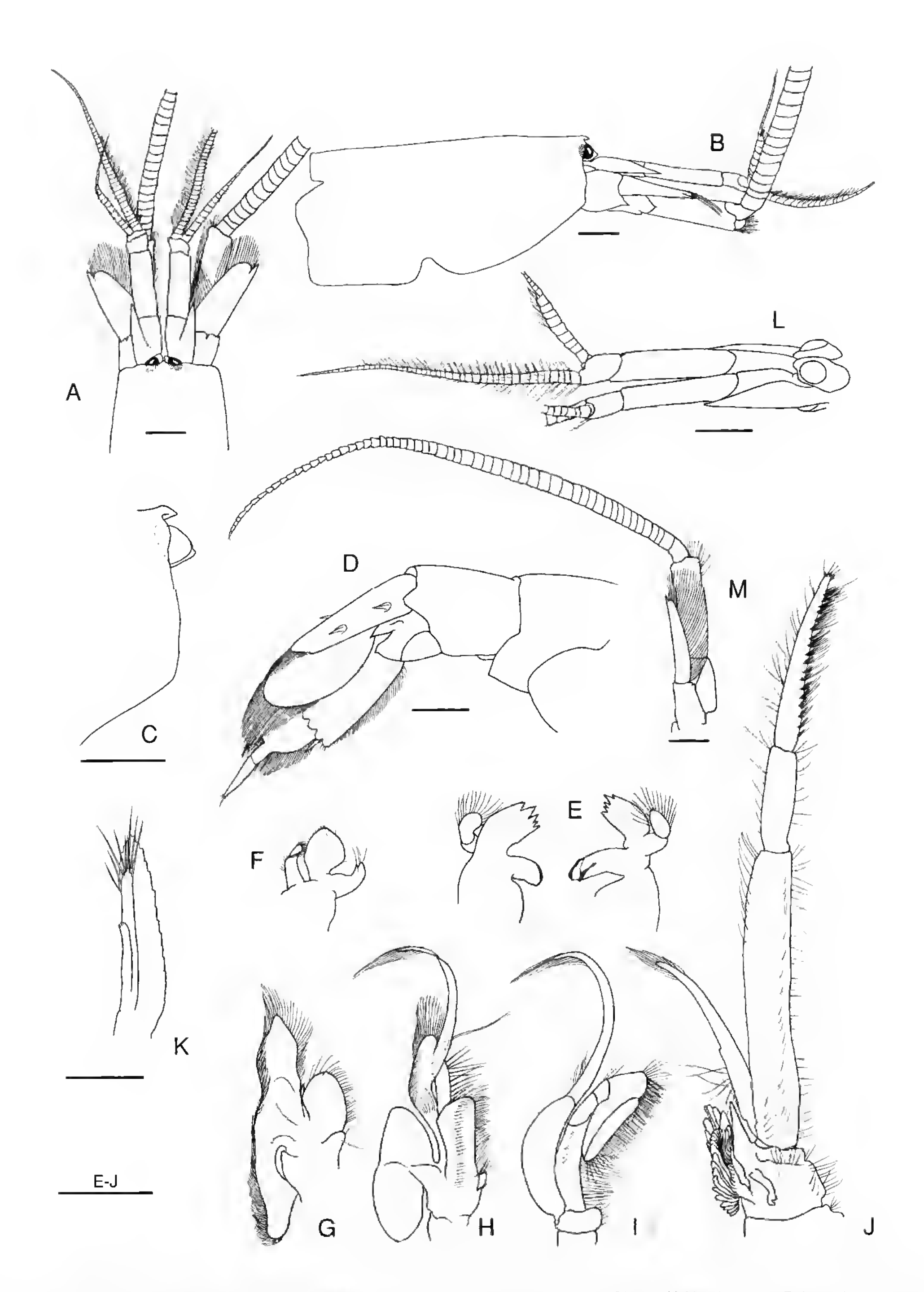


FIG. 2. — *Cavipelta yamashitai* n.sp., A-K, holotype, ♂ from Miyajima Island, 7.3 mm CL (NFU No. 530-2-1877); L-M, paratype, ♂ from Miyajima Island, 6.4 mm CL (NFU No. 530-2-1878, part); **A**, anterior part of body, dorsal view; **B**, same, lateral view; **C**. anterior part of carapace and eye, lateral view; **D**, posterior part of abdomen, lateral view; **E**, right mandible, outer (left) and inner (right) view; **F**, right maxillula; **G**, right maxilla; **H**, right first maxilliped; **I**, right second maxilliped; **J**, right third maxilliped; **K**, appendix interna and appendix masculina; **L**, thoracic appendages, oblique view; **M**, right antenna, ventral view. Scales bars: A-J, L, M, 1.0 mm; K, 0.5 mm.

with outer margin straight, ending in distinct spine overreaching lamella; flagellum rigid, and strengthened, more than twice as long as carapace (Figs 1, 2A, M).

Mouthparts not specific. Mandible composed of medium-sized molar process, broad incisor process with several teeth distally and 2-segmented palp attached to base of incisor process (Fig. 2E). Maxilla with broad distal endite and small proximal endite (Fig. 2G). First maxilliped with 2-segmented endopod, proximal segment small with stiff hair distally; epipod large, oval (Fig. 2H). Second maxilliped with long exopod and oblong epipod (Fig. 2I). Third maxilliped reaching distal end of antennal peduncle, with arthrobranch, strap-like epipod and long exopod; large flattened process present on coxa; proximal segment as long as distal two segments combined; distal segment less than twice as long as intermediate segment, with many rows of brush-like setae on lower margin and five short apical spines (Fig. 2J).

First pereopod massive, equal, usually extended forward. In males overreaching end of antennal peduncle by chela; ischium less than half as long as merus, pointed at dorsodistal end; merus cylindrical, 1.8 times as long as ischium, with row of small spine-like processes on dorsal margin; carpus 1.2 times as long as ischium with one or two similar processes on dorsal margin. Chela as long as merus, palm cylindrical with small excavation near proximal articulation and few low processes just anterior of excavation; fingers curved mesially at right angle to palm in most specimens, or slightly backward in larger males; articulation of fingers present near outer distal part of palm and movable finger situated horizontally at anteriormost position; immovable finger with two large irregular teeth on cutting edge and movable finger with usually small tooth on cutting edge (Figs 3A, B, 4F). In ovigerous females first pereopod not specific; movable finger articulated normally with outer distal side of palm; fingers compararively small, less than half as long as palm; dorsodistal end of ischium pointed; dorsal margin of merus serrated, but carpus smooth. In females and small males first pereopod similar to ovigerous females in general shape but merus and ischium with smooth margins (Fig. 4G).

Second pereopod reaching end of antennal scale, equal, slender; merus as long as ischium; carpus longer than merus, 5-segmented, proximal and distal segments subequal and longer than intermediate three segments; chela slightly shorter than distal two segments of carpus (Fig. 3C). Third pereopod overreaching antennal peduncle by dactylus; ischium with small spine on outer surface; merus about twice as long as ischium, unarmed; carpus as long as ischium with small spine on lower distal corner; propodus about 1.5 times as long as carpus, with three or four spines on posterior margin and one pair of spines on distal end; dactylus simple, acute, one half as long as propodus (Fig. 3D). Fourrh pereopod reaching disral end of antennal; shape and spination similar to third pereopod (Fig. 3E). Fifth pereopod slenderer, reaching distal end of stylocerite; ischium and carpus unarmed; propodus with several rows of setae on distal half and one or two spines on proximal third or middle of posterior margin (Fig. 3F).

First pleopod bilobed, not specific in either sex. Endopod of second to fifth pleopods with slender appendix interna in both sexes. Male second pleopod with slender appendix masculina nearly twice as long as appendix masculina, but falling short of distal end of endopod; several long setae present near apex of masculina (Fig. 2K). Uropod broad, longer than telson; protopod ending in two pointed processes; endopod broad, oval, not specific (Figs 2D, 4H-J). Diaeresis of exopod with nine to fourteen, usually nine to eleven, rounded immovable lobes, outer two or three lobes subequal in size and larger than inner; outer margin of exopod ending in spinule situated at outer margin of outermost spine of diaeresis; distinct acute spine present under outermost or second spine of diaeresis (Figs 2D, 4H-J). Distal end of exopod with long flap in large males; in some specimens more than half of exopod, and composed of two or three segments (Figs 2D, 4H, I, K).

BIOLOGY

According to Yamashita (1980), the present species was found associated with the thalassinid *Upogebia major* (De Haan), on the tidal flat of Miyajima Island. He found that this shrimp swam out from the *Upogebia* burrow in which he

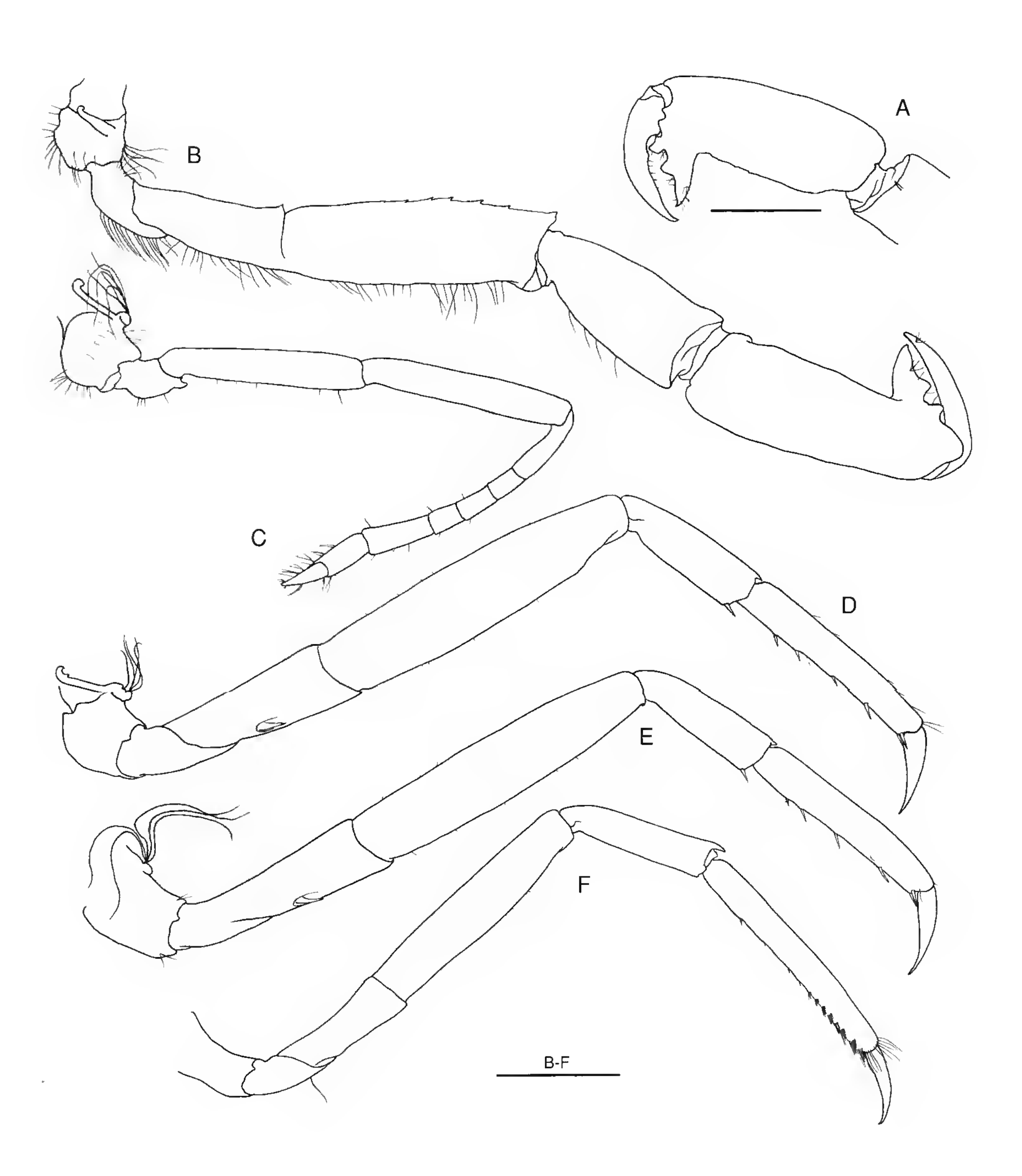


FIG. 3. — *Cavipelta yamashitai* n.sp., holotype, ♂ from Miyajima Island, 7.3 mm in CL (NFU No. 530-2-1877). **A**, chela of left first pereopod, mesial view; **B**, right first pereopod, outer view; **C**, right second pereopod, outer view; **D**, right third pereopod, outer view; **E**, right fourth pereopod, outer view; **F**, right fifth pereopod, outer view. Scale bars: 1.0 mm.

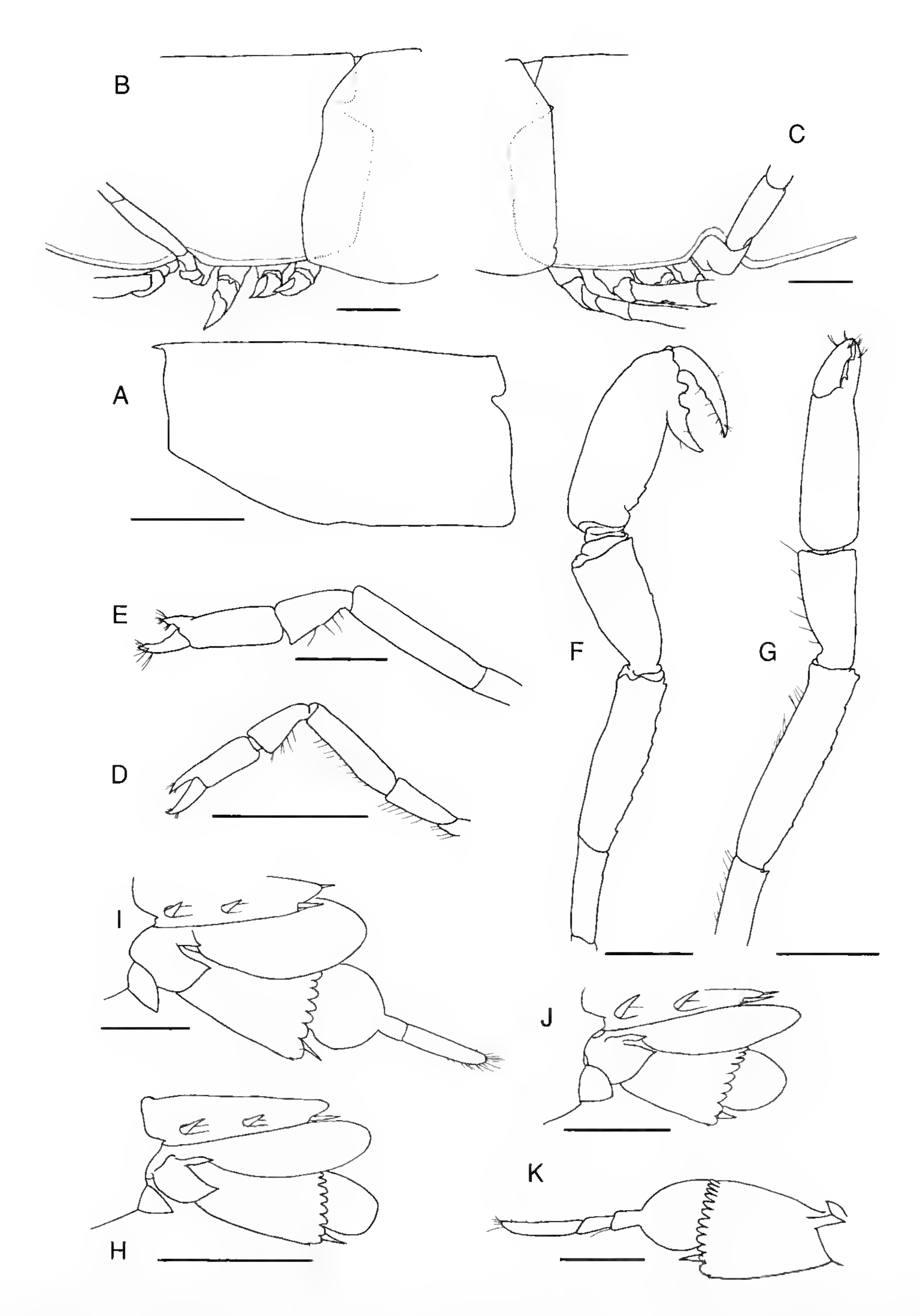


FIG. 4. — *Cavipelta yamashitai* n.sp. paratypes, A, E, ♀ from Toyo Port, 5.2 mm in CL (NFU No. 530-2-1880, part); B, G, ovigerous ♀ from Miyajima Island, 6.7 mm in CL (NFU No. 530-2-1878, part); C, ♂ from Miyajima Island, 6.9 mm in CL (NFU No. 530-2-1878, part); D, H, ♂ from Toyo Port, 3.1 mm in CL (NFU No. 530-2-1880, part); F, K, ♂ from Toyo Port, 6.3 mm in CL (NFU No. 530-2-1880, part); I, ♂ from Miyajima Island, 7.0 mm in CL (NFU No. 530-2-1878, part); J, ovigerous ♀ from Miyajima Island, 5.0 mm in CL. **A**, carapace, lateral view; **B**, **C**, posterior part of carapace, lateral view; **D-G**, left first pereopod, lateral view; **H-J**, tail-fan, oblique view; **K**, exopod of left uropod, oblique view. Scale bars: 1.0 mm.

poured a plaster to examine the shape of the burrow. Many specimens of this species were collected from the *Upogebia* burrow using this same method. The other material from Toyo Port indicates the possibility of the association with other than thalassinid shrimps, because the label indicates that it was collected together with *Callianassa japonica* Ortmann, *Upogebia major* and the bivalve *Mactra veneriformis* Reeve. All other specimens of this species were collected from tidal flats of the southwestern part of Japan.

Remarks

As mentioned above, Yamashita (1980) briefly described and illustrated this species under the name of *Athanas* sp. Part of his specimens are included in the present material examined.

Some important characters show considerable variation with sex and growth. The sinus on the lower margin of carapace is less developed or entirely absent in specimens less than 5.0 mm (Fig. 4A-C). The larger specimens always bear this sinus, and it is larger and deeper in males than in females. Judging from its position and shape it may be related to the smooth movement of the first (or second) pereopod.

The first pereopod of the large males morphologically differs from that of the females and the smaller males, especially the chela (Figs 1, 2B, 4D-G). The ovigerous females and small specimens have a normal slender chela, although with rough margins on the ischium and merus in ovigerous females. In large males the chela is curved mesially, and in the male from Toyo Port, the immovable finger is bent backward with two large teeth on the cutting edge. The palm, carpus, merus and ischium are provided with small spine-like processes on the mesial margin.

A long flap-like process extends from the outer margin of the exopod of uropod in large males only. It is entirely absent from ovigerous females and small specimens (Figs 2D, 4H-K). The long flap is composed of two or three joints. The function of this appendix could not be determined.

Acknowledgements

I wish to express my sincere thanks to Mr Kinji Yamashita, Mr Yoichi Ide, Dr M. Amio and Dr Tatsuo Hamano, who kindly sent me these interesting specimens. It is a great pleasure to contribute to the present volume dedicated to Dr Alain Crosnier, who has contributed so much to our knowledge of decapod crustaceans. I am also indebted to Dr Fenner A. Chace, Jr. and Dr Rafael Lemaitre, for reading the manuscript and offering valuable suggestions.

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New genus and species of Calanticidae (Cirripedia, Thoracica, Scalpellomorpha) from Australian waters

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Jones D. S. 1998. — New genus and species of Calanticidae (Cirripedia, Thoracica, Scalpellomorpha) from Australian waters. *Zoosystema* 20 (2) : 239-253.

ABSTRACT

A previously undescribed calanticid species was found in the collections of the Australian Museum, Sydney. The combination of features match some of the characteristics of the genus *Smilium*, as currently defined, and do not fulfil the necessary criteria for inclusion in any of the remaining calanticid genera. Several characters, however, are typical of *Calantica*. Therefore, a new genus and species is proposed and is accordingly named *Crosnieriella acanthosubcarinae*. The uncertain relationships between the presently recognized calanticid genera are discussed.

KEY WORDS
Crustacea, Thoracica, Scalpellomorpha, Calanticidae, deep water, Coral Sea, Australia, new species.

RÉSUMÉ

Un nouveau genre et une nouvelle espèce de Calanticidae (Cirripedia, Thoracica, Scalpellomorpha) des eaux australiennes. Une espèce non encore décrite des collections de l'Australian Museum à Sydney rappelle par certains de ses caractères le genre *Smilium*, tel qu'il est actuellement défini, et ne satisfait pas aux critères qui permettraient de l'inclure dans l'un des autres genres de la famille. Plusieurs caractères sont cependant typiques de *Calantica*. En conséquence, un genre nouveau et une espèce nouvelle sont proposés sous le nom de *Crosnieriella acanthosubcarinae*. Les affinités, incertaines, entre genres de Calanticidae actuellement reconnus sont discutées.

MOTS CLÉS
Crustacea, Thoracica, Scalpellomorpha, Calanticidae, eau profonde, Mer du Corail, Australie, nouvelle espèce.

INTRODUCTION

The relationships between the calanticid genera have long been uncertain, with various genera and differing numbers of attributed genera having been assigned to the family. There has never been a revision of this poorly known, largely relictual group of scalpellomorphs that includes several clades, the boundaries between which are generally blurred by intermediate forms. The situation has been further confused by the chaotic species-level taxonomy within *Calantica* Gray, 1825 and *Smilium* Gray, 1825. Various species have been transferred from one genus to the other, and sometimes back again, with little substantive reason. For example, at various times both *C. pollicipedoides* (Hoek, 1907) and *C. trispinosa* (Hoek, 1883) have been removed to *Smilium* and then subsequently re-included in *Calantica* (see Pilsbry 1908; Calman 1918; Weltner 1922; Broch 1931; Zevina 1981). Similarly, *S. zancleanum* (Seguenza, 1876) was removed to *Calantica* and then later reassigned to *Smilium* (see Withers 1953; Foster 1978). *Calantica peduncolostriata* Broch, 1931 is currently removed to *Smilium* (see Liu & Ren 1985). Other species [for example *C. kampeni* (Annandale, 1909), *C. scorpio* (Aurivillius, 1892), *C. spinilatera* Foster, 1978], which were originally assigned to *Smilium*, have been removed subsequently to *Calantica* (see Broch 1931; Utinomi 1962; Foster 1978).

This paper does not attempt to deal with these problems, as these will be reviewed elsewhere. I am currently revising the calanticid genera and will re-evaluate the status of the new genus at that time.

MATERIALS AND METHODS

Specimens were examined with the aid of microscopy and dissection, and illustrations of the whole animal were made with the aid of a camera lucida. Shell architecture was investigated by X-ray images of whole specimens (holotype, cap. 25.1 mm, AM P40986; paratype, cap. 22.2 mm, AM P49989) and of a bisected specimen (paratype, cap. 28.7 mm, AM P49989), and soft parts were cleared, stained with Solophenyl Blue 2RL and mounted, according to the method of Jones (1993). The appendages and the mouthparts were drawn with the aid of a camera lucida. All measurements are in millimetres. The terminology follows that of Jones (1990, 1992) and Newman (1987, 1991, 1996). The holotype and the paratypes are deposited in the Australian Museum, Sydney (AM).

Abbreviations

c.a.	caudal appendage;
cap.	capitular length;
mls	miles;
ped.	peduncular length.

SYSTEMATICS

Superorder THORACICA Darwin, 1854
Order PEDUNCULATA Lamarck, 1818
Suborder SCALPELLOMORPHA Newman, 1987
Family CALANTICIDAE Zevina, 1978 (emend.)

Diagnosis

Pedunculata with capitulum protected by six primary calcareous plates or their rudiments, namely rostrum (R), carina (C), paired scuta (S) and terga (T), three pairs of latera, including rostrolatera (RL), latera (L) and carinolatera (CL) and (except for *Pisiscalpellum*) a subcarina (SC), plus various other supplementary capitular plates (r-c) to a total of 60^{+} plates, with as few as nine in reduced forms; umbo of carina apical, sometimes subcentral; plates arranged in two more or less distinct whorls, those in lower whorl either overlapping, or being overlapped by, adjacent plates. Peduncle usually with rows of uniform-sized calcareous scales. Caudal appendages setose, sometimes multi-articulate. Basic mandible with three teeth, lower angle pectinate, sometimes smaller extra teeth below first tooth. Maxillule lacking step-like cutting edge. Small males often associated with larger hermaphrodites or females; males clearly divided into peduncle and capitulum, with six or more small capitular plates.

REMARKS

Zevina (1978) divided the Scalpellidae into eight subfamilies, based on the number of capitular plates and their degree of development, the position of the umbos, the number of segments in the caudal appendages and the degree of development of the males. The Calanticinae embraced five genera, namely *Calantica* Gray, 1825, *Euscalpellum* Hoek, 1907, *Paracalantica* Utinomi, 1949, *Scillaelepas* Seguenza, 1876 and *Smilium* Gray, 1825. Zevina included *Pollicipes* Leach, 1817 in the Pollicipinae and *Pisiscalpellum* Utinomi, 1958 in the Scalpellopsinae. Subsequently, in a revision of the fossil barnacles of New Zealand and Australia, based solely on capitular plate architecture, Buckeridge (1983) placed the genera *Calantica* and *Smilium*, together with *Pollicipes, Pisiscalpellum, Capitulum* Oken, 1815 and the fossil genera *Zeugmatolepas* Withers, 1913 and *Titanolepas* Withers, 1913 in the Calanticinae. Buckeridge also recognized *Scillaelepas* as a subgenus of *Calantica* but placed *Euscalpellum* in the Scalpellinae. Newman (1987, 1991, 1996) elevated the subfamily Calanticinae to full familial status and set aside a number of fossil genera in a new family, the Zeugmatolepadidae Newman, 1996.

The inclusion of *Smilium, Calantica* and *Scillaelepas* within the Calanticidae is undisputed, but it is evident that a satisfactory diagnosis has yet to be produced. The confused taxonomy of the scalpellomorph family Calanticidae was briefly reviewed by Jones & Lander (1995).

Crosnieriella n.g.

TYPE SPECIES. — *Crosnieriella acanthosubcarinae* n.sp., by monotypy.

ETYMOLOGY. — The genus is named in honour of my friend and colleague Dr Alain Crosnier, both as an appreciation of his scientific endeavours and as a tribute to his monumental efforts in supporting studies on deep water marine fauna, in particular those associated with the MUSORSTOM expeditions.

DIAGNOSIS

*? Hermaphrodite with a basic plan of nineteen capitular plates, including six primary plates, namely rostrum (R), carina (C), paired terga (T) and scuta (S), two subcarinae (SC^1, SC^2), five pairs of latera including carinolatera (CL^1, CL^2), latera (L^1, L^2), and rostrolatera (RL), and a subrostrum (SR), plus up to sixteen supplementary capitular plates (r-c); upper lateral (L^1) placed between scutum and carina, carinal margin not developed; scutum with basal margin angular; umbos of carina and scutum subapical. Filamentary processes present. Caudal appendages uniarticulate.

*? Complemental male attached between scuta and adductor muscle.

(* Vestigial penis of *Crosnieriella acanthosubcarinae* n.sp. suggests known specimens are likely female with dwarf males.)

REMARKS

Crosnieriella n.g. is most similar to *Smilium* and shares some characters with *Calantica*, but the apomorphic replication of the plates at the carinal end of the capitulum distinguish *Crosnieriella* n.g. from these two genera. *Smilium* has a basic plan of thirteen capitular plates, with a total of up to fifteen (*S. horridum* Pilsbry, 1912) to as few as nine plates [*S. hypocrites* (Barnard, 1924)]. *Calantica* also has a basic plan of thirteen capitular plates, with a total of 60^+ to as few as eleven plates [both extremes occur in *C. spinosa* (Quoy *et* Gaimard, 1834)].

In *Crosnieriella* n.g., the upper latus (L^1) is partly elevated from the lower whorl of capitular plates, where a new latus (L^2) replaces it. L^1 moves to a position between the carina and the scutum, but does not develop a distinct carinal margin. In *Calantica*, the tergum is between the carina and the scutum and the median latus (L) remains in the lower whorl. In *Smilium*, L^1 has a distinct carinal margin and is not part of the lower whorl of capitular plates, being well elevated between the carina and the scutum. The position of L^1 is more obviously a part of the lower whorl of capitular plates in fossil *Smilium* species (e.g., *S. tortachillense* Buckeridge, 1983 and *S. subplanum* Withers, 1924) but it is transitionally placed in Recent species (Buckeridge 1983).

Buckeridge (1983) considered *Smilium* as the most derived taxon within the Calanticidae, and regarded it as showing the closest relationship

with the more modified scalpellines. He retained *Smilium* in the Calanticidae due to the large size of the rostrum, a plesiomorphic character, and to the position of L^1. Foster (1978) had previously defined a quadrangular L^1, placed between the scutum and the carina, as characteristic of *Smilium*. This shape results from the development of a carinal margin.

In *Crosnieriella* n.g., the basal margin of the scutum is angular. Foster (1978) included within *Smilium* those species with an almost 90° bend in the basal margin of the scutum. Buckeridge (1983) broadened Foster's interpretation, and considered that the basal margin needs only to be clearly angular, suggesting that the basal margin became progressively angular through the Cenozoic, resulting in some of the acutely angular Recent taxa such as *S. acutum* Hoek, 1883.

Crosnieriella acanthosubcarinae n.sp.
(Figs 1-6)

TYPES. — Holotype, ? hermaphrodite, cap. 25.1 mm (AM P 40986). 2 paratypes, ? hermaphrodites, cap. 22.2 mm, cap. 28.7 mm (AM P 49989).

MATERIAL EXAMINED. — **Australia.** 9 mls NE One Tree Island, Capricorn Group, Queensland, 22°27'S - 152°15'E, 175 m, 08.II.1969, coll. B. Goldman, J. Paxton, J. Veevers: 3 specimens (AM P 40986).

ETYMOLOGY. — The species is named in reference to the two spine-like subcarinae on the capitulum.

DISTRIBUTION. — All specimens were collected from the type locality, from a mud and shell bottom, 175 m.

DIAGNOSIS

Basic plan of nineteen fully-calcified, calcareous plates, plus various small supplementary plates, resulting in complement of up to thirty-five capitular plates, arranged in three consecutive whorls; two pairs of horn-like carinolatera (CL^1, CL^2); two spine-like subcarinae (SC^1, SC^2); lower whorl with variable number (up to sixteen) of small, thorn-like supplementary capitular plates (r-c) arranged in tiers; upper latus (L^1) placed between scutum (S), tergum (T), carina (C) and carinolateral^1 (CL^1); acute basi-tergal angle of upper latus (L^1) angled toward carina. Peduncle covered with numerous calcareous, small, peg-like, non-imbricating scales arranged in three to seven distinctly separated, raised, horizontal bands, separated by contracted bands of peduncle. One pair of small, nipple-like filamentary appendages on prosoma. Maxilla with densely setose band close to, and extending length of, cutting margin.

DESCRIPTION

Large individuals ? hermaphrodite. Capitulum

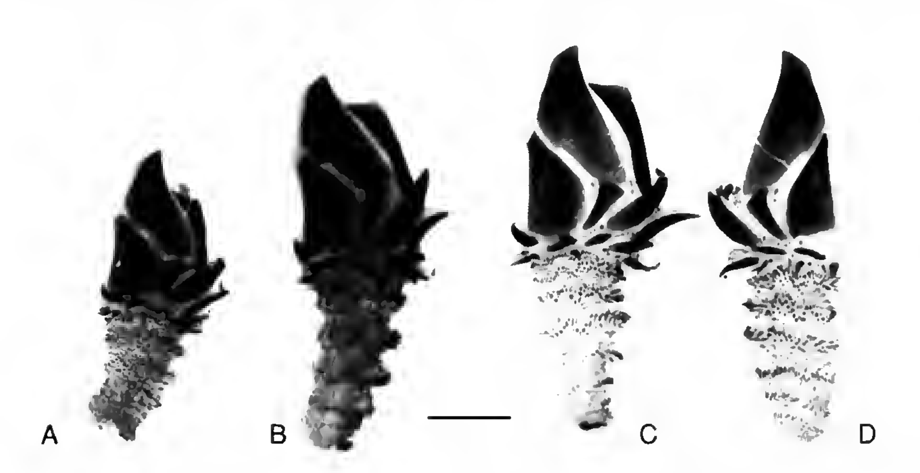


FIG. 1. — *Crosnieriella acanthosubcarinae* n.sp., ? hermaphrodites, X-ray. **A**, paratype, cap. 22.2 mm, whole specimen from right side (AM P49989); **B**, holotype, cap. 25.1 mm, whole specimen from right side (AM P40986); **C**, paratype, cap. 28.7 mm, bisected specimen, right side (AM P49989); **D**, paratype, cap. 28.7 mm, bisected specimen, left side (AM P49989). Scale bar: 10 mm.

laterally compressed; irregularly subtriangular, higher than wide; apex oblique, slightly reflexed towards carinal side. Occludent margin of capitulum sinusoidal, carinal margin subparallel to occludent margin in lower one half to three quarters. Three whorls of fully calcified, dirty-white capitular plates; plates covered by moderately thick, finely setose, yellowish membrane, outline of plates often indistinct; surfaces of plates marked with faint transverse growth lines, plates separated by distinct interspaces, all plates entirely covered by cuticle. Capitular architecture with basic plan of nineteen plates, plus various small supplementary plates, resulting in a total of up to thirty-five capitular plates (Figs 1-4).

Rostrum (R) triangular, more than twice as wide as high, similar in size to upper lateral (L^1); plate curved outward, free from capitulum, apex acute, curved upward and inward toward capitulum. Scutum (S) subtriangular to quadrangular, higher than wide; occludent and tergal margins forming acute, upwardly directed angle, tip not projecting from occludent margin; umbo subapical, acute tip slightly projecting from occludent margin; rostral and upper latus margins subequal, shorter than occludent and tergal margins; upper latus margin subparallel to occludent margin, rostral margin almost straight; internally adductor muscle pit prominent. Tergum (T) elongated, narrow, triangular, apex subacute, slightly reflexed towards carinal side; occludent margin gently convex, narrow process appended on upper one third; scutal margin not straight, excised with small, shallow, triangular indentation, creating spur in upper one third; carinal margin longest, almost straight, apically retroverted in upper one quarter. Carina (C) extending above apex of upper lateral (L^1) to three quarters length of tergal margin, apex meeting margin of tergum at angle of 110°; carina internally concave, externally laterally compressed; carina angularly flexed in distal one sixth, lower portion wider and three times longer than upper portion, both portions meeting at angle of 120°, umbo at angle; carinal roof externally laterally convex, growing wider from umbo downwards, sides relatively wide and flattened in upper portion; plate basally rounded, overlain laterally by carinolatus^1 (CL^1).

Fig. 2. — *Crosnieriella acanthosubcarinae* n.sp., ? hermaphrodite, paratype, cap. 28.7 mm (AM P49989), viewed from the left side. **C**, carina; **CL**, subcarina; **L**, latera; **R**, rostrum; **RL**, rostrolatera; **S**, scuta; **SC**, subcarina; **SR**, subrostrum; **T**, terga; **r**, **c**, supplemenary capitular plates.

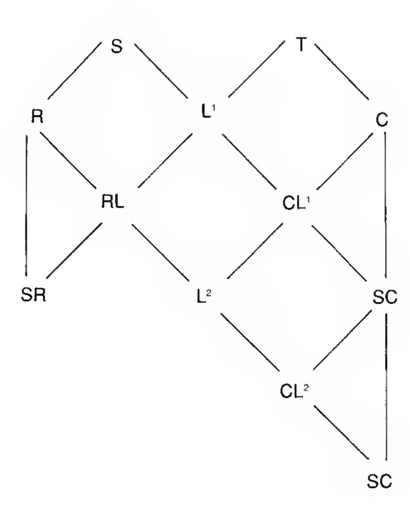


Fig. 3. — *Crosnieriella* n.g., diagram of basic capitular armament, viewed from the right side: 10 plates.

Upper latus (L^1) triangular, basal margin elongated, sinuous; scutal margin subequal to basal margin, concave; tergal margin shortest margin, almost straight; apex curved inward, retroverted towards scutum, apex slightly overlying tergum in largest specimen examined. Rostrolatus (RL) triangular, similar to but smaller than rostrum; curving outward, free from capitulum, apex curved upward or inward. Inframedian latus (L^2) similar to rostrolatus in size, triangular, higher

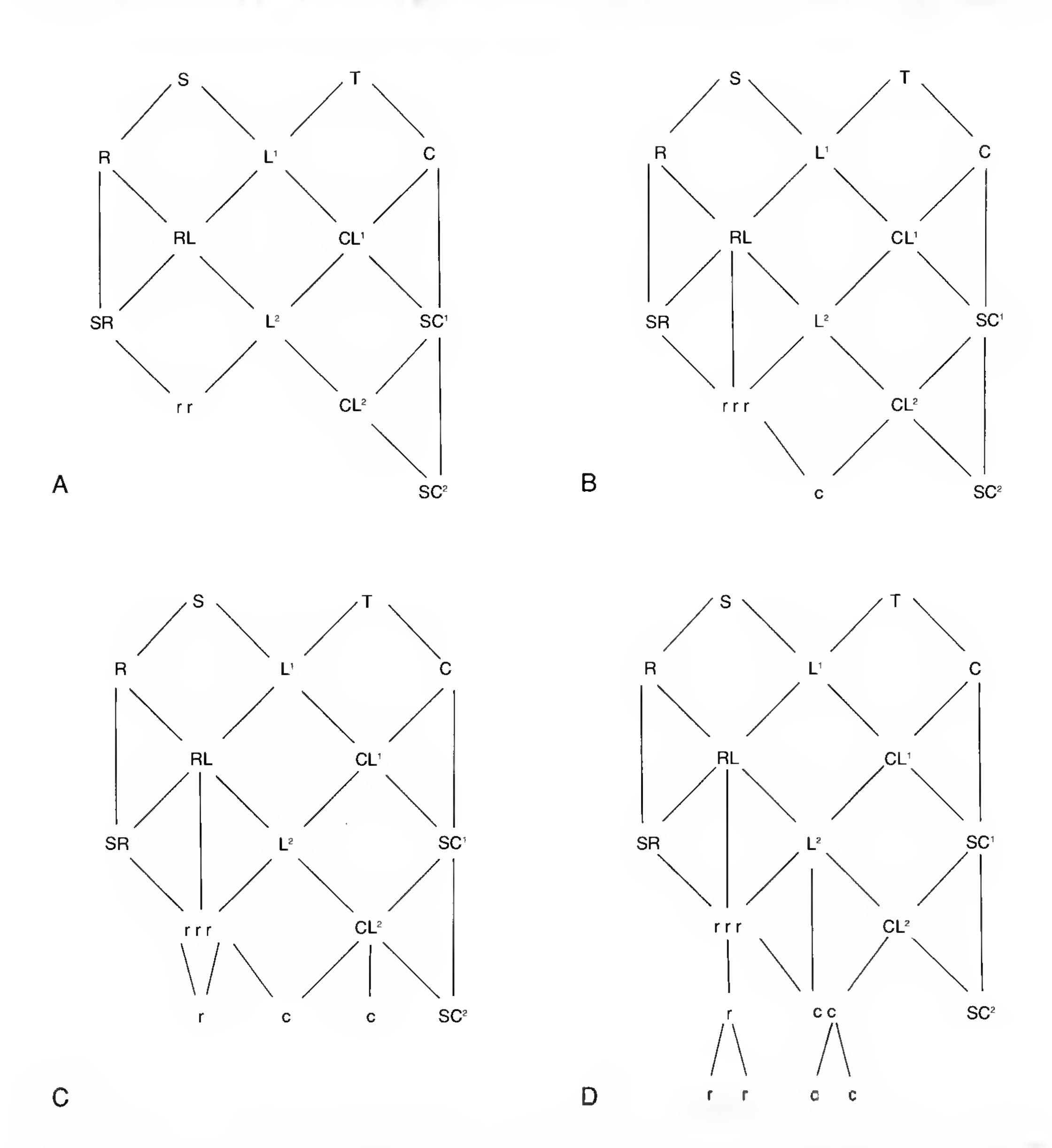


FIG. 4. — *Crosnieriella acanthosubcarinae* n.sp., diagrams illustrating the relative positions of supplementary capitular plates (r-c) found on different individuals from the same population [terminology follows that of Newman (1987)]. **A**, right side of capitulum, paratype, cap. 22.2 mm (AM P49989); **B**, left and right sides of capitulum, holotype, cap. 25.1 mm (AM P40986) and left side of capitulum, paratype, cap. 22.2 mm (AM P49989); **C**, left side of capitulum, paratype, cap. 28.7 mm (AM P49989); **D**, right side of capitulum, paratype, cap. 28.7 mm (AM P49989).

than wide; curving outward, free from capitulum, apex curved outward or downward. Carinolatus^1 (CL^1) horn-like, similar in size to subcarina^1 (SC^1); curving outward, free from capitulum, subacute apex pointing outward or retroverted toward carina. Subrostrum (SR) smaller than rostrum, thorn-like, curving outward, apex pointing upward or downward from capitulum. Subcarina^1 (SC^1) spine-like, more than twice as large as rostrum; curving outward free from capitulum, apex pointing outward or downward. Subcarina^2 (SC^2) spine-like, similar to SC^1 in shape but smaller in size; curving outward free from capitulum, apex pointing upward, outward or downward. Carinolatus^2 (CL^2) horn-like, similar to SC^1 in shape but smaller in size, larger and more developed than L^2. Small supplementary capitular latera (r-c) arranged in tiers (Figs 2, 4A-D); thorn-like, height four times width, apices pointing outward and downward. Small, closely spaced, calcareous spicules, similar to small peduncular scales, in inter-spaces between S and L^1, R and SR, RL and L^1, L^2 and L^1, CL^1 and L^1, CL^1 and SC^1, CL^1 and CL^2, CL^2 and SC^2, spicules outlining shape of plates.

Peduncle yellowish, conico-columnar, subequal to, or shorter than, length of capitulum; covered with numerous, calcareous, small, peg-like, non imbricating, whitish scales; scales arranged in three to seven distinctly separated, raised, convoluted, lateral bands, separated by lateral contracted bands of peduncle; each raised band consisting of two to three rows of larger, peg-like scales; near pedunculo/capitular junction scales upright in position, gradually turning outward and downward in progression down peduncle; scales longer, more dense on carinal side of peduncle; contracted areas between raised bands with smaller peg-like scales, upright in position wherever their peduncular placement.

Ovigerous frenae apparently absent; eggs not present. Posterior edge of intercalary fold between cirri III and IV with one pair of filamentary appendages developed as downward-directed, nipple-like projections.

Labrum strongly bullate, teeth absent. Mandibular palp ovate, setose, long setae distally. Mandible with four teeth, upper largest, second smallest, large subsidiary tooth between teeth one and two, sometimes small subsidiary tooth between teeth two and three; margins of all teeth without serrations; lower angle pectinate. Maxillule with distinct, densely setose band close to and extending length of cutting edge; one large stout and two smaller setae at upper angle; margin without notch, indistinctly stepped, crowded with numerous setae of unequal length, setae in paired groups of four to six; lower angle slightly protuberant, with seven to eight pairs of smaller setae. Maxilla almost quadrangular; continuous series of finely serrulate setae along all margins. Chaetotaxy ctenopod. Cirral formula as follows:

Cirrus		I	II	III	IV	V	VI	c.a.
paratype (cap. 28.7 mm)	right	14/16	23/25	26+/29	26/28	28/27	25/27	1
	left	13/16	23/25	26/27	27/22+	28/25	22/27	1

Cirrus I not separated from cirrus II, rami subequal, anterior ramus shorter than posterior; proximal segments of anterior ramus protuberant anteriorly and posteriorly; segments of both rami setose, setation more dense on inner surfaces, setae finely serrulate. Cirrus II longer than cirrus I; rami subequal, anterior ramus slightly longer than posterior; proximal segments of anterior ramus slightly protuberant anteriorly, segments of both rami becoming elongated distally; distal segments of anterior ramus with two to three pairs of long setae on anterior faces, distal segments of posterior ramus with two to four pairs of long setae on anterior faces; proximal segments of both rami more densely setose, setae finely serrulate; bunches of long, finely serrulate setae at postero-distal corner of segments. Cirrus III slightly longer than cirrus II; rami subequal, segments of both rami becoming elongated distally; distal segments of both rami with two to four pairs of long setae on anterior faces, proximal segments more densely setose, setae finely serrulate; bunches of long, finely serrulate setae at postero-distal corner of segments. Cirrus IV-VI similar, longer than cirrus III; rami

subequal, segments oblong, bearing four pairs of setae on anterior faces, first two pairs longest, setae finely serrulate; bunches of long, finely serrulate setae at postero-distal corner of segments. Caudal appendages small, one third height of basal segment of pedicel of cirrus VI; uniarticulate, leaf-like; few sparse, small, terminal setae distally, minute spines on inner surface. Penis minute, one sixth height of basal segment of pedicel of cirrus VI; setae and annulations absent.

Dimensions:

	capitulum length	capitulum width	peduncle length	peduncle width	total length
holotype	25.1	20.8	29.2	11.7	54.3
paratype	22.2	14.5	16.3	10.5	38.5
paratype	28.7	22.2	22.7	11.4	51.4

Single complemental male located between scuta, near occludent margin, just above adductor muscle; peduncle longer than capitulum; six well-developed capitular plates; tergum diamond-shaped, beaked apex retroverted towards occludent margin; scutum subtriangular; carina equilateral triangular; rostrum similar to carina but smaller.

Discussion

The generic placement

The new genus described herein is included in the family Calanticidae. It has a combination of features which match most, but not all, of the characteristics of the calanticid *Smilium*, as currently defined, although several characters are more typical of *Calantica* and one character (the presence of filamentary appendages) is not typical of either *Smilium* or *Calantica*. The following characters were considered when assessing the generic status: the position of the upper latus (L^1), the position of the umbos of the capitular plates, the form of the scutum, the form of the complemental male, the tendency to form extra plates on the capitulum, the form of the cirri, the presence of a subrostrum, and the presence of filamentary appendages.

The position of the upper latus (L^1)

The diagnosis for *Calantica* states that the tergum occupies the whole space between the scutum and the carina (Pilsbry 1907, 1908; Withers 1953; Newman *et al.* 1969), and a similar capitular plate arrangement also occurs in *Scillaelepas* and *Pisiscalpellum*. Thus in *Calantica*, the median latus (L) is situated in the lower whorl of plates (together with the subcarina, the carinolateral and the rostrolateral), below the primary plates. There are, however, some species presently included in *Calantica* that have a partially elevated upper latus occupying some of the space between the scutum and the carina – e.g. *C. pollicipedoides*; *C. pusilla* Utinomi, 1970. In these species the upper latus is triangular or subtriangular and a carinal margin is not developed. This contrasts to past diagnoses for *Smilium*, which emphasize the presence of the median latus which has moved up between the scutum and the carina. In *Smilium* the median latus (L^1) is elevated, from the lower whorl of plates to a position above the carinolatus, below the tergum and between the scutum and the carina, and a new latus (L^2) replaces it below. In the process, L^1 develops a distinct carinal margin and becomes subquadrate, quadrate, or pentagonal, although in the latter case it often appears superficially triangular. Within *Smilium*, however, *S. horridum* and *S. scorpio* (synonym of *S. sexcornutum* Pilsbry, 1907 and *C. pedunculostriata*) possess a triangular L^1 which is partially elevated between the scutum and the carina. In *Euscalpellum* the quadrangular or pentagonal L^1 occupies a similar position to that in *Smilium*. The L^1 is absent in *Paracalantica*.

In *Crosnieriella* n.g., L^1 is placed below the tergum and between the scutum and the carina. Its position, however, although elevated between the carina and the scutum, is not totally above the carinolateral (CL^1), as in *Smilium* and *Euscalpellum*, but more in line with CL^1 and above the other latera. Although the basi-tergal angle of L^1 of *Crosnieriella acanthosubcarinae* n.sp., which is directed toward the carina, distinctly separates the tergum and CL^1, a carinal margin is not developed; the shape of L^1 is thus triangular, not quadrangular. The L^1 of *C. pusilla*, *C. pollicipedoides* and *S. horridum* are similarly

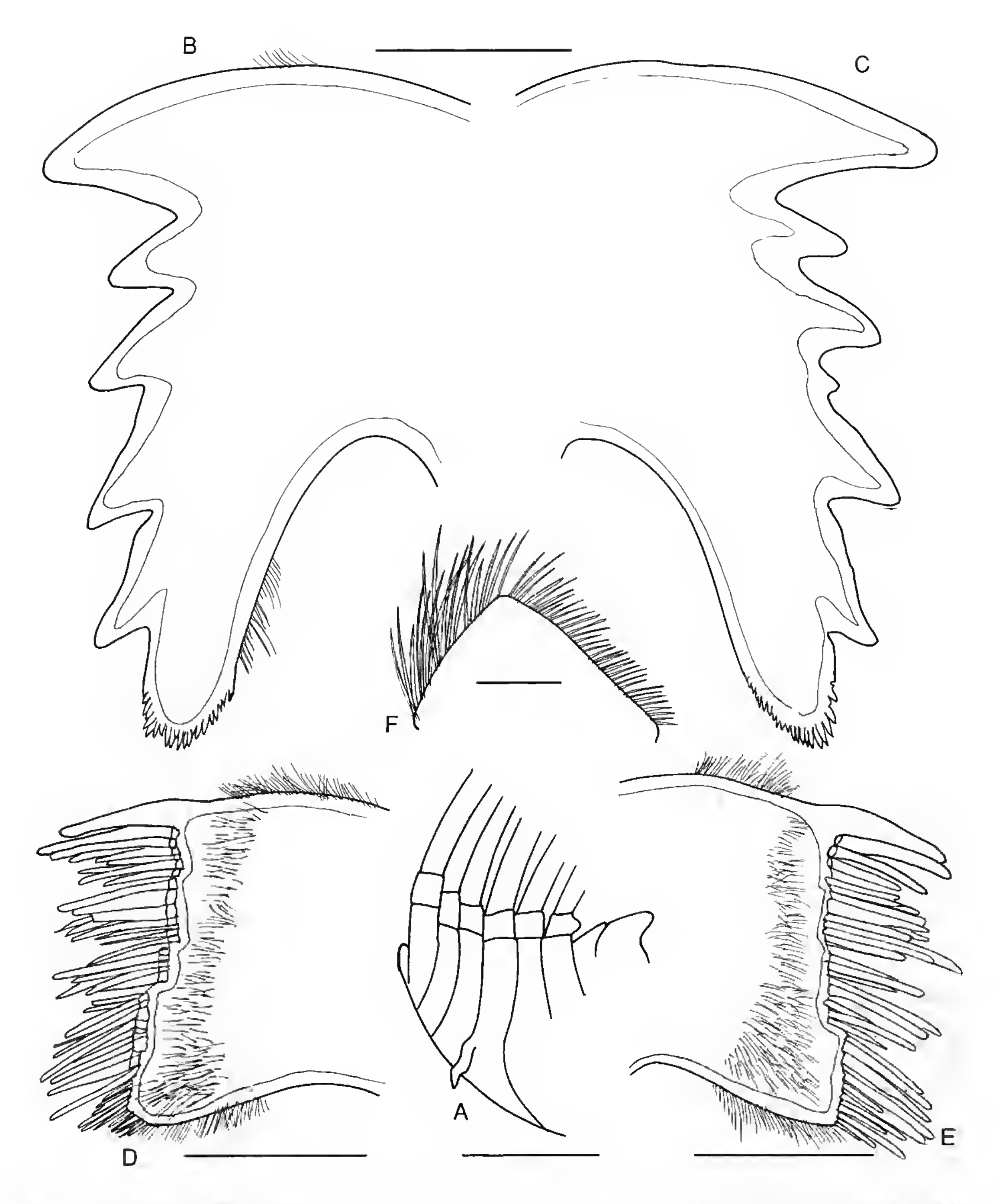


Fig. 5. — *Crosnierella acanthosubcarinae* n.sp., ? hermaphrodite, paratype, cap. 28.7 mm (AM P49989). **A**, lateral view of prosoma to show filamentary appendages, **B**, left mandible; **C**, right mandible; **D**, left maxillule; **E**, right maxillule; **F**, left maxilla. Scale bars: A-E, 0.5 mm; F, 0.05 mm.

shaped and similarly placed. In these species the plate is in a transitional position, between the upper and the lower whorls of capitular plates. This is intermediate between the arrangement found in *Calantica* and that occurring in *Smilium* and *Euscalpellum*.

The position of the umbos of the capitular plates
In *Crosnieriella* n.g. the carina and the scutum have subapical umbos. In *Calantica, Pisiscalpellum* and *Scillaelepas* the umbos of all the capitular plates are apical; in *Paracalantica* and *Titanolepas* all the umbos are apical apart from that of the scutum. In *Smilium* the umbos of the carina, the scutum and the upper latus may be apical or subapical. The umbo of the upper latus is subcentral or apical in *Euscalpel-lum*, with that of the scutum either subcentral, subapical or apical, and that of the carina subcenrral or apical.

The form of the scutum
The basal margin of the scutum of *Crosnieriella* n.g. is clearly angular in form. Foster (1978) considered *Smilium* to include those scalpellids where, as well as a quadrangular upper latus (L^1), an angular scutal basal margin is developed. The bend is almost 90° and, in consequence, the scutum acquires rostral and upper latus margins on either side of the apico-basal ridge. Using these criteria Foster (1978) suggested that *S. scorpio* should be assigned to *Calantica* and, on the basis of the structure of the scutum, that *Smilium* should include the fossil forms *S. subplanum, C. sulci* Withers and *Scalpellum zancleanum*. Buckeridge (1983), however, also included within *Smilium* calanticids having the basal margin of the scutum clearly angular. On this basis, *C. scorpio sensu* Foster (1978) would thus be re-insrated within *Smilium*.

The form of the male
Calantica, Euscalpellum, Paracalantica, Pisiscalpellum, Scillaelepas s.l. and *Smilium* carry males, either in the integument between the scuta near the adductor muscle (*Calantica, Euscalpellum, Paracalantica, Smilium*), in a subrostral position (*Scillaelepas*), or inside the scutum near the apex (*Pisiscalpellum*). The male of *Euscalpellum* is nor differentiated into capitulum and peduncle and has a total of three capitular plates (a pair of elongated scuta and a rudimentary carina). In *Paracalantica* the complemental male has four large capitular plates and rudimentary terga, with the short peduncle wholly buried in the cuticle of the hermaphrodite. The males of *Calantica, Paracalantica* and *Smilium* are differentiated into peduncle and capitulum, the latter with six well-developed capitular plates. The males of *Crosnieriella* n.g. are differentiated into a capitulum with six well-developed capitular plates and a peduncle which is longer than the capitulum. On the capitulum of the calanticid male, as well as the six primary plates, small median latera sometimes develop.

The tendency to form supplementary latera on the capitulum
Whilst the presence of small, supplementary latera appears to be characteristic of *Crosnieriella*, their number and disposition on the capitulum appear to be variable (Figs 1A-D, 2, 3A, C). The interpretation of the capitular architecture of *Crosnieriella acanthosubcarinae* n.sp. is based solely on three specimens from one locality, and more material from several different populations is needed to fully document the complement of supplementary capitular latera. Yamaguchi & Newman (1997) emphasized variability in the pattern and number of basal imbricating plates in the balanomorph genus *Eochionelasmus* Yamaguchi, 1990 (*in* Yamaguchi & Newman 1990), and have since been able to distinguish populations from the Manus, North Fiji and Lau Basins (Newman pers. comm.; Yamaguchi & Newman 1997).
The tendency to develop a variable number of small supplementary capitular latera often with varying numbers on each side of the capitulum, is recognized in some species of *Calantica*. Hoek (1907) recorded two supplementary latera on one side of one of his six specimens of *C. pollicipedoides*, in addition to the three that all the specimens possessed and Hiro (1932) similarly noted two additional larera on one side of a specimen of *C. quinquilatera* Hiro, 1932. Four or five pairs of supplementary capitular latera are developed in *C. spinilatera*, and in *C. spinosa* a variable number

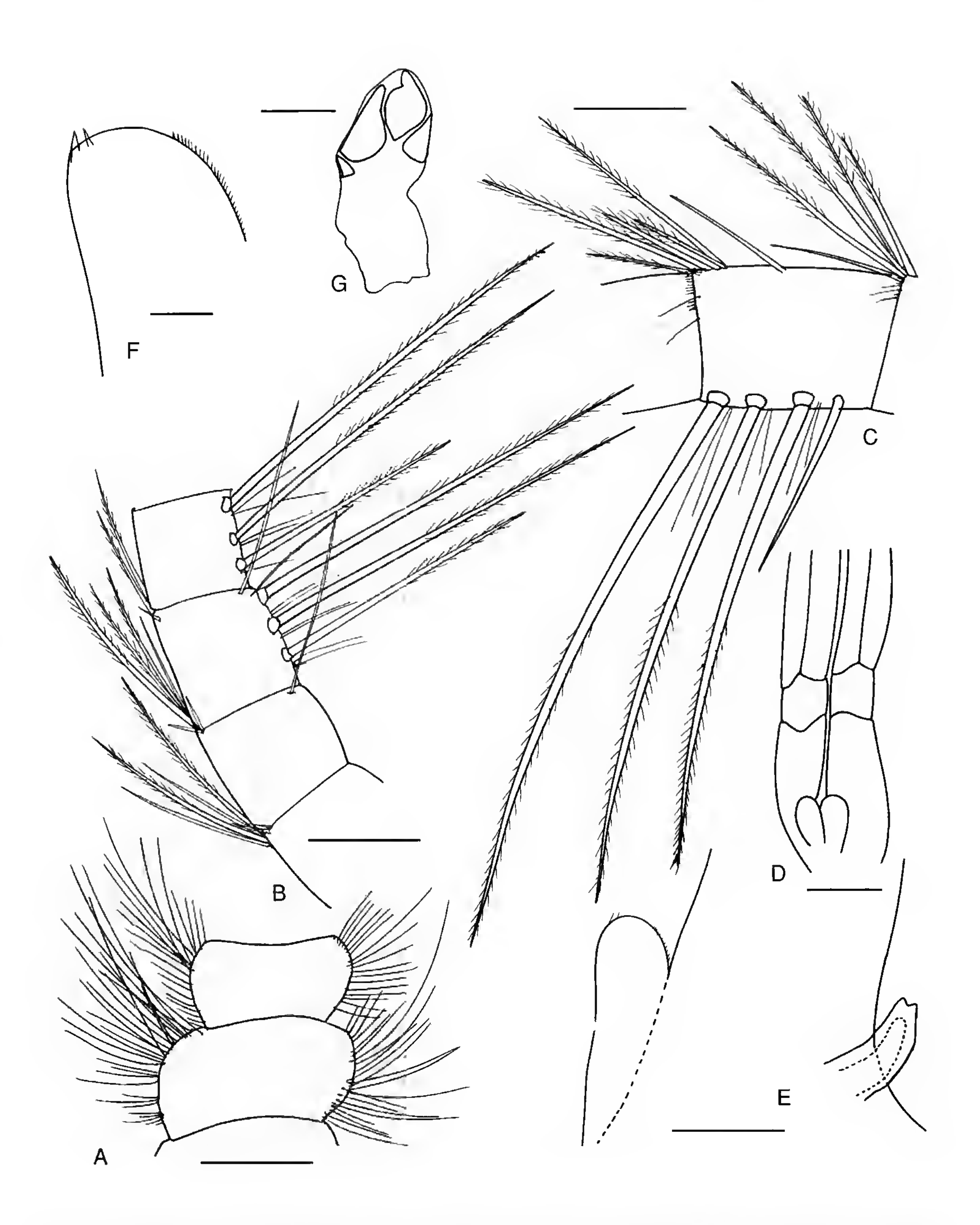


FIG. 6. — *Crosnieriella acanthosubcarinae* n.sp., ? hermaphrodite, paratype, cap. 28.7 mm (AM P49989). **A**, cirrus I, median segments, posterior ramus; **B**, cirrus II, median segments, posterior ramus; **C**, cirrus III, median segments, posterior ramus; **D**, posterior view, caudal appendages and pedicels of posterior cirrus VI; **E**, caudal appendage and penis at base of basal segment of pedicel of cirrus VI; **F**, detail of caudal appendage; **G**, complemental male. Scale bars: A-C, E, G, 0.5 mm; D, 1 mm; F, 0.1 mm.

of small latera develops, often varying in number on each side, and additionally the subrostrum may be present or absent (Darwin 1851; Batham 1945, 1946; Foster 1978). The inframedian latus (L^2) may be reduced or absent in some *C. kampeni* (Broch 1931) and this plate may also be reduced on one side in *C. quinquelatera* (Hiro 1932).

The form of the cirri

The appendages have been described for some species of *Smilium* and *Calantica*. However, considering the existing confused species taxonomy, it would be unwise to attempt to characterize the form of the cirri found in these two genera. The following data regarding the form of the cirri in the calanticids have been extracted from the literature.

In *C. quinquelatera*, *S. acutum*, *S. nudipes* Annandale, 1916, *S. peronii* Gray, 1825, *S. sinense* (Annandale, 1910) and *S. zancleanum* the rami of cirrus I are unequal and there is a pronounced interspace between cirrus I and cirrus II. In *Pisiscalpellum* the rami of cirrus I are unequal and cirrus I is set somewhat apart from cirrus II. In *Euscalpellum rostratum* Darwin, 1851 cirrus I is set far apart from cirrus II and the rami are subequal. In *Crosnieriella acanthosubcarinae* n.sp. cirrus I is not separated from cirrus II, and the rami are subequal.

In *C. kampeni*, *C. pollicipedoides*, *C. scorpio*, *C. spinilatera*, *C. spinosa* and *S. hypocrites* cirrus I has subequal rami and there is no pronounced interspace between cirrus I and cirrus II. In *Scillaelepas* (*S.*) *fosteri* Newman, 1980 and *S.* (*S.*) *gemma* (Aurivillius, 1892) cirrus I is set only slightly apart from cirrus II and the rami are subequal.

The presence of a subrostrum

The subrostrum is absent in *Pisiscalpellum* and *Scillaelepas* (*Scillaelepas*), but one subrostrum occurs in *Scillaelepas* (*Aurivillias*) Newman, 1980, and two in *Scillaelepas* (*Gruveliaelepas*) Newman, 1980. Some species of *Calantica* possess a subrostrum (e.g. *C. quinquelatera*, *C. villosa* Leach, 1824, *C. spinosa*). The fossil species *S. calanticoideum* Buckeridge, 1983 and *S. tortachillense* also possess a subrostrum but this plate is absent in Recent *Smilium* species. The possession of a subrostrum in *Crosnieriella* n.g. is thus not surprising, especially regarding the close relationship between *Crosnieriella* and *Smilium*, the latter assumed to have been derived from *Calantica* (Buckeridge 1983). *Crosnieriella acanthosubcarinae* n.sp. is, therefore, considered to be close to these early representatives of *Smilium*.

The presence of filamentary appendages

Crosnieriella acanthosubcarinae n.sp. has one pair of small filamentary appendages. Filamentary appendages occur in one species of *Euscalpellum* (*E. triflagellum* Ren, 1989; three filamentary appendages); in *Aurivillialepas* Newman, 1980 (three sets); and *Gruvelialepas* Newman, 1980 (one or two sets). Filamentary appendages are absent in *Smilium*, *Calantica*, *Paracalantica*, *Pisiscalpellum* and *Scillaelepas* s.s.

After consideration of the above characters, a new genus, *Crosnieriella*, is proposed for the material described herein. However, I am currently revising the calcanticids and the definitive genus name will be determined in the context of that revision, as will the relationships between the genera in the family. It is pertinent here to note Foster's (1978) comment that, apart from characters of the capitular plates, there are few anatomical differences between *Calantica* and *Smilium* but "if *Smilium* is to be retained as a distinct genus, then a revision of *Calantica* will no doubt identify groups as distinct from each other as from *Smilium*".

Specific relationships of Crosnieriella acanthosubcarinae *n.sp.*

Considering Recent species of *Smilium*, *Crosnieriella acanthosubcarinae* n.sp. is most similar to *S. horridum* but differs in aspects of both hard- and soft-part morphology. *Smilium horridum* has a basic plan of fifteen capitular plates in two whorls, whereas *Crosnieriella acanthosubcarinae* n.sp. has a basic plan of nineteen plates, plus various small supplementary plates, resulting in a total of up to thirty-five capitular plates arranged in three whorls, with the supplementary plates arranged in tiers. Both species have large, thorn-like subcarinae[1] (SC^1) and horn-like carinolatera[1] (CL^1), the distal tips of which project freely from the capitulum; in both species

SC[1] is much larger than the rostrum. The shape of the tergum of *S. horridum* is triangular, with a broad process appended on the occludent side of the summit which is, therefore, very obtuse. The tergal summit of *Crosnieriella acanthosubcarinae* n.sp. is subacute and slightly reflexed towards the carina, and the plate is elongated, narrow and triangular, with a narrow process appended on the occludent side.

The form and arrangement of the peduncular scales differs between the two species. The peduncle of *S. horridum* is densely covered with small, pebble-like scales. On the carinal side are two longitudinal series of larger, more projecting scales and on one side there is another indistinct series of similar scales. The peduncular scales of *Crosnieriella acanthosubcarinae* n.sp. are peg-like and are more developed on the carinal side than on the rostral side of the peduncle. They are arranged in three to seven convoluted, lateral bands, which are distinctly separated by contracted areas of the peduncle.

The mandible of *S. horridum* has three main teeth, whilst that of *Crosnieriella acanthosubcarinae* n.sp. has four. In *S. horridum* the second and third teeth are similarly sized, and there are small subsidiary teeth between the first and second, whilst in *Crosnieriella acanthosubcarinae* n.sp. the second tooth is the smallest, a moderately large subsidiary tooth is present between the first and second teeth, and a small subsidiary tooth is sometimes present between the second and third.

Crosnieriella acanthosubcarinae n.sp. is known from near One Tree Island, Queensland, Australia, from a depth of 175 m. *Smilium horridum* is a smaller species (cap. 12.0 mm, ped. 11.0 mm) and occurs in shallow water (42 m) in the Philippines.

Crosnieriella acanthosubcarinae n.sp. also shows similarities to *S. pollicipedoides* in the development of the carinolatera[1] (CL[1]), although their degree of development is much greater in *Crosnieriella acanthosubcarinae* n.sp. *Smilium pollicipedoides* has a basic plan of fifteen capitular plates in two whorls, with all plates in the lower whorl small and triangular, with their apices pointing outward. The apex of the scutum projects beyond the occludent margin and the tergum is rhomboidal, rather than triangular as in *Crosnieriella acanthosubcarinae* n.sp. The rostrum of *S. pollicipedoides* is the largest valve and is slightly larger than the subcarina[1] (SC[1]), rather than SC[1] being much larger than the rostrum, as in *S. pollicipedoides*. In addition, the carina of *S. pollicipedoides* is not angularly bent, but varies from gently convex to almost straight.

There are slight differences in the form of the mandible between the two species. Both species have four main teeth; *S. pollicipedoides* has two small subsidiary teeth between the first and second teeth, whereas *Crosnieriella acanthosubcarinae* n.sp. has a moderately large subsidiary tooth between teeth one and two, and sometimes a small subsidiary tooth between teeth two and three. The cirral counts differ between the two species, with almost twice as many segments in cirrus I and more than twice as many in cirrus II in *Crosnieriella acanthosubcarinae* n.sp. compared to *S. pollicipedoides* (14/16 and 23/25 compared to 7/9 and 9/9, respectively).

Smilium pollicipedoides, which occurs in the Malayan Archipelago and South Africa in depths of 57-190 m, is a much smaller species than *Crosnieriella acanthosubcarinae* n.sp. (cap. 6.0 mm, ped. 6.0 mm compared to 25.1 mm, 29.2 mm, respectively).

Calantica scorpio, known from the waters of Japan, China, the Gulf of Thailand and the Malayan Archipelago from depths of 35-140 m, has a basic plan of thirteen capitular plates developed in two whorls. The species is similar to *Crosnieriella acanthosubcarinae* n.sp. in the positions of the carinolatera[1] (CL[1]), and the subcarina[1] (SC[1]), although these plates are much less developed in *C. scorpio*. The form of the hooked rostrolatera differs between the species, being curved and varying from horn-like to thorn-like in *C. scorpio* but triangular in *Crosnieriella acanthosubcarinae* n.sp. In *C. scorpio*, the rostrum and SC[1] are of similar size, rather than SC[1] being much larger than the rostrum, as in *Crosnieriella acanthosubcarinae* n.sp.

The carina of *C. scorpio* is gently recurved in the upper part towards the tergum and almost straight in its distal half, rather than being angularly bent. The peduncular scale arrangement also differs between the two species. In *C. scorpio* the peduncle is covered with minute, well-

spaced, hook-like scales placed in three to ten spaced, lateral bands, and in older specimens some longitudinal stripes may develop on the peduncle.

Cirral counts also differ between the two species. There are a similar number of segments in cirrus I (14/16 *Crosnieriella acanthosubcarinae* n.sp., 13/14 *C. scorpio*) but there are more segments in cirrus II and the remaining cirri in *Crosnieriella acanthosubcarinae* n.sp. (*e.g.* for CII and CVI, 23/25 and 25/27 compared to 15/16 and 20/19).

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Three new species of thalassinidean shrimps (Crustacea, Axiidae and Calocarididae) from Taiwan

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ABSTRACT

Three new species of Thalassinidea are described from deep water (350-400 m) off Taiwan: *Acanthaxius formosa* and *Acanthaxius grandis* (family Axiidae), and *Calastacus crosnieri* (family Calocarididae). The latter is the first record of the genus from the western Pacific, and the fifth species to be described. Six species of *Acanthaxius* have previously been described, five from the Pacific, and one from the western Atlantic.

KEY WORDS
Crustacea,
Decapoda,
Thalassinidea,
Axiidae,
Calocarididae,
Taiwan,
new species.

RÉSUMÉ

Trois nouvelles espèces de thalassinides (Crustacea, Axiidae et Calocarididae) de Taïwan. Trois nouvelles espèces de thalassinides sont décrites de Taïwan par 350-400 m de profondeur : *Acanthaxius formosa* et *A. grandis* (famille des Axiidae) et *Calastacus crosnieri* (famille des Calocarididae). Pour cette dernière, il s'agit de la première découverte de ce genre dans l'ouest du Pacifique et de la cinquième espèce décrite. Six espèces d'*Acanthaxius* avaient été précédemment décrites, cinq du Pacifique et une de l'Atlantique occidental.

MOTS CLÉS
Crustacea,
Decapoda,
Thalassinidea,
Axiidae,
Calocarididae,
Taïwan,
nouvelle espèce.

INTRODUCTION

There have been few publications on axiids and calocaridids from the South and East China Sea region around Japan, Taiwan, and Korea. The more recent of these include Yokoya (1933), Miyake & Sakai (1967), Sakai (1987, 1992), Sakai & de Saint Laurent (1989), Kensley & Komai (1992). In all, only about fifteen species are known from the region, none from Taiwan. The three new species described here suggest that many more await discovery in what is known to be a region of high marine biodiversity.

MATERIAL AND METHODS

All the specimens reported here were obtained from the catches of commercial deep-sea trawlers in the fishing ports of Taiwan. The fishing grounds are close to the home ports, to which the trawlers return with their catch each day.

Unless otherwise stated, specimens are deposited at the National Taiwan Ocean University (NTOU) and the National Museum of Natural History, Smithsonian Institution (USNM).

Carapace length (cl) is measured from the orbital margin to the posterior margin of the carapace.

SYSTEMATICS

Family AXIIDAE Huxley, 1878
Genus *Acanthaxius*
Sakai *et* de Saint Laurent, 1989

Acanthaxius formosa n.sp.
(Figs 1A, 2)

MATERIAL EXAMINED. — **Tong-Kong.** Ping Tong County, south-western coast, sandy mud bottom, about 350 m, 5.VIII.1996: holotype ♂ cl 18.0 mm (NTOU H-1996-8-5).

Paratypes: all from Tong-Kong, Ping Tong County, south-western coast, sandy mud bottom, about 350 m, 5.VIII.1995: 2 ♀♀ cl 14.9 mm, 16.2 mm (NTOU P-1995-8-5). — 5.VIII.1996: 4 ♂♂, cl 15.5-16.9 mm, 1 ♀ cl 17.0 mm, 1 ovig. ♀, damaged (NTOU P-1996-8-5). — 2.XII.1995: 1 ♂ cl 15 mm (USNM 253357). — 5.VIII.1996: 1 ♂ cl 15 mm, 1 ovig. ♀ cl 15.2 mm (USNM 253358).

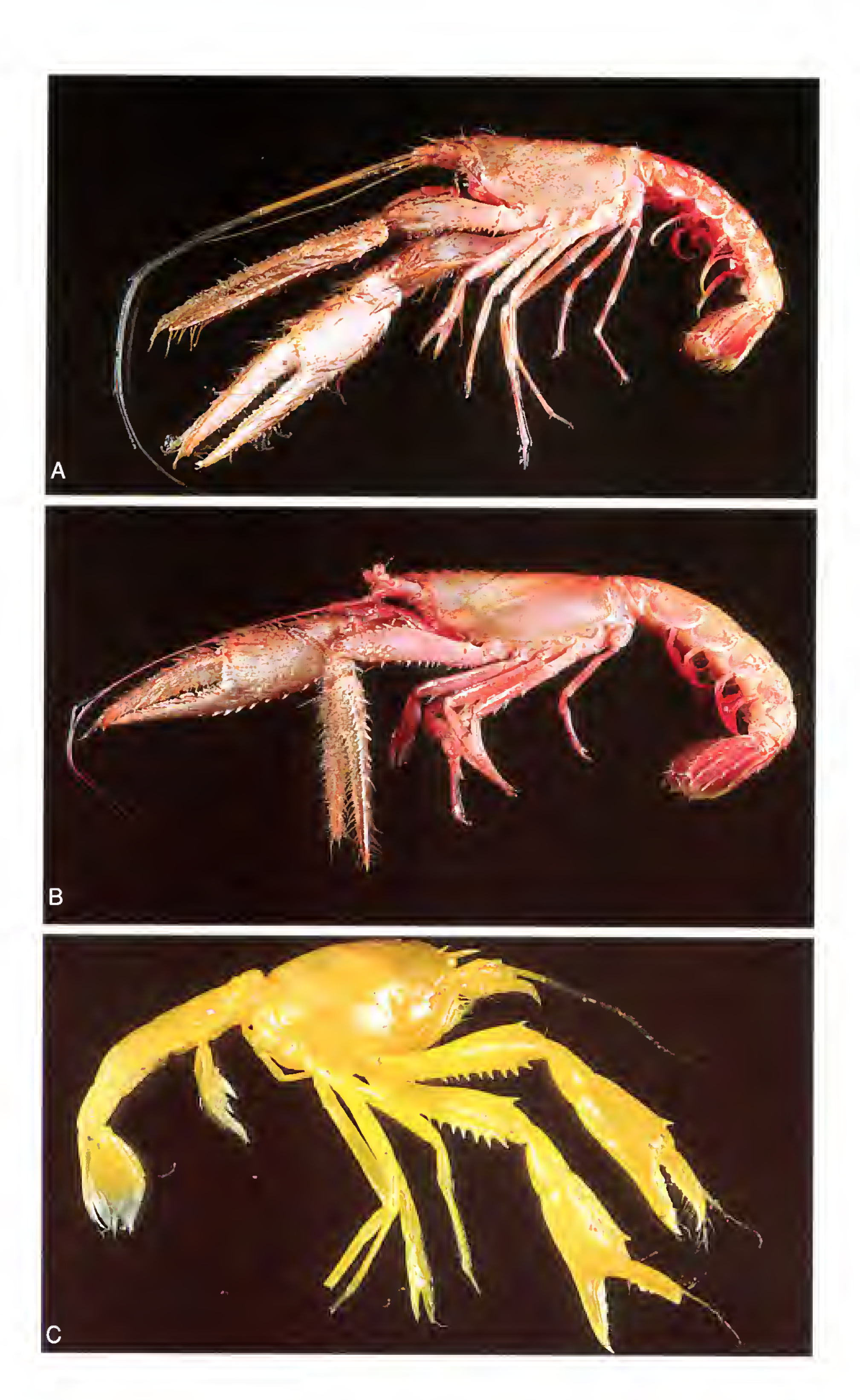
ETYMOLOGY. — The specific name is from the earlier name of the island of Taiwan, *viz.* Formosa, and is used as a noun in apposition.

DESCRIPTION

Carapace (Fig. 2A, B) with rostrum reaching just beyond eyes to distal margin of article 2 of antennular peduncle, with three pairs of lateral teeth, flanked by pair of strong supraorbital spines; median carina reaching onto rostrum, bearing up to sixteen spines; lateral carina bearing nine to ten spines, anteriormost largest; two rows of small spines between median and lateral carinae, of about ten and five to six spines each; cervical groove well-marked, with few spines on dorsal edge; postcervical carapace and branchiostegites bearing numerous small spines or rounded tubercles. Pleuron of abdominal somite 1 triangular, ventrally acute; pleura 2 and 3 ventrally broadly rounded; pleura 4-6 with low ventral tooth (Fig. 2A). Telson (Fig. 2C) slightly longer than wide, with small median spine on posterior margin, two pairs of small movable posterolateral spines; two pairs of small spines on dorsal surface.

Antennal acicle slender, curved, reaching distally to base of distalmost peduncular article. Pereopod 1, larger cheliped (Fig. 2D) quite heavily setose, merus with nine spines on ventral margin, four or five spines on dorsal margin, with few scattered distolateral spines; carpus with three spines on dorsal margin, few scattered spines on lateral surface; propodal palm with five spines on dorsal margin, row of forwardly-directed sometimes overlapping spines on ventral margin, running almost to apex of fixed finger, lateral surface with numerous rounded and subacute tubercles; dactyl with ten spines on dorsal margin; cutting edges of both fingers having numerous rounded tubercles. Pereopod 1, smaller cheliped (Fig. 2E), merus bearing eight to nine spines on ventral margin, five spines on dorsal margin, few scattered distolateral spines; carpus with three spines on dorsal margin, few scattered spines and tubercles on lateral surface; propodal palm with five spines on dorsal margin,

FIG. 1. — **A**, *Acanthaxius formosa* n.sp.; **B**, *Acanthaxius grandis* n.sp.; **C**, *Calastacus crosnieri* n.sp.


A
B
C

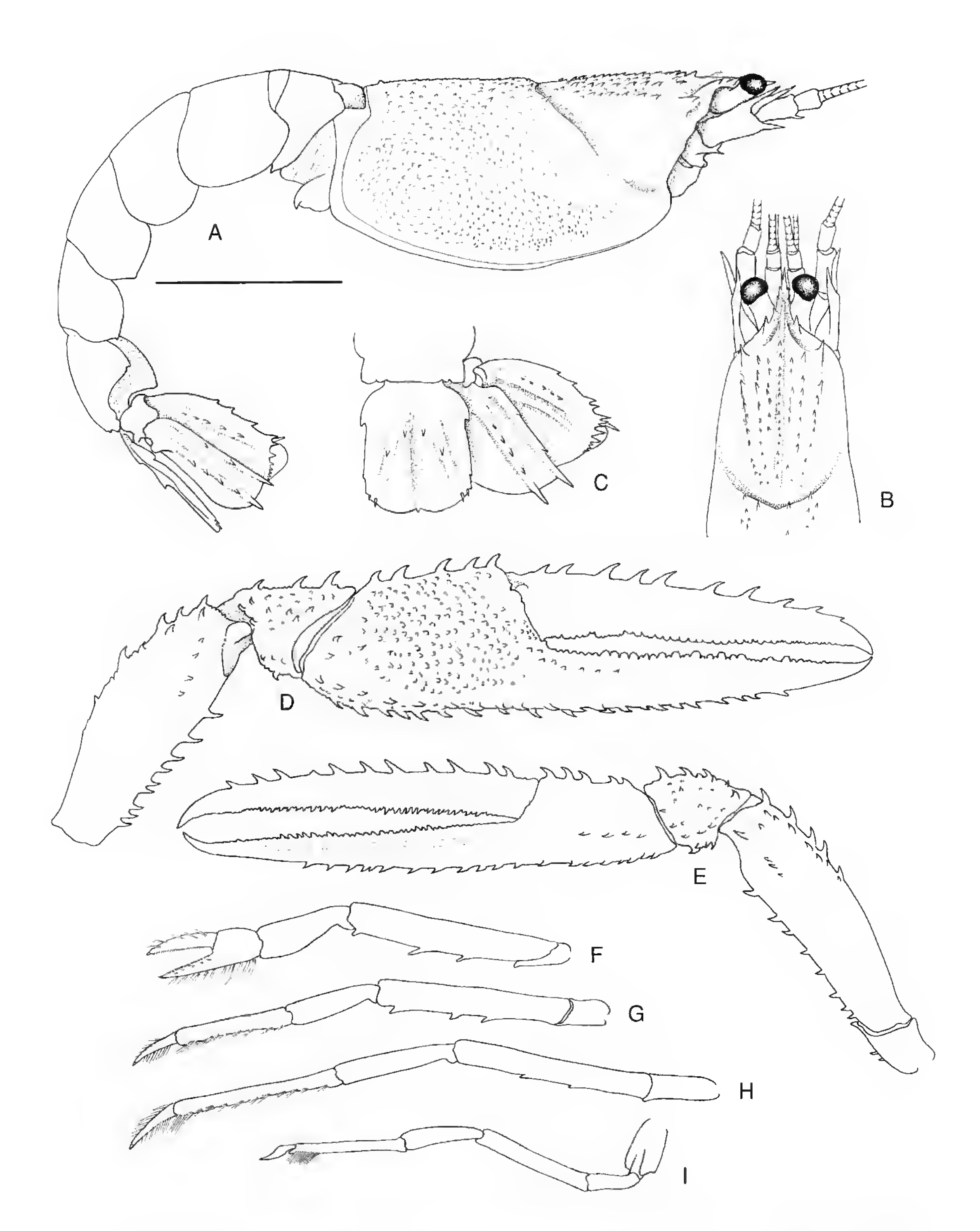


FIG. 2. — *Acanthaxius formosa* n.sp.; **A**, lateral view: **B**, anterior carapace in dorsal view; **C**, telson and right uropod; **D**, pereopod 1, larger cheliped, setae omitted; **E**, pereopod 1, smaller cheliped, setae omitted; **F**, pereopod 2; **G**, pereopod 3; **H**, pereopod 4; **I**, pereopod 5. Scale bar: 10 mm.

few spines on lateral surface, row of about twenty distally-directed spines on ventral margin running onto fixed finger; dactyl with eleven spines on dorsal margin; cutting edges of both fingers having acute and rounded tubercles and teeth. Pereopod 2 (Fig. 2F), merus with three spines on venrral margin. Pereopod 3 (Fig. 2G), merus with three spines on ventral margin. Pereopod 4 (Fig. 2H), merus with two small teeth on ventral margin. Pereopod 5 (Fig. 2I), merus unarmed. Uropodal lateral ramus having four spines on lateral margin, seven spines along suture, slender movable spine at junction, dorsal ridge bearing five small spines; mesial ramus with three spines on lateral margin, distalmost largest, five spines on dorsal ridge, distalmost largest (Fig. 2C).

Colour: body orange, ventrally lighter; abdomen with large pale lateral patches; legs orange, paler at articulations. Eyes dark brown.

Remarks

Acanthaxius formosa belongs to the group of three species characterized by possessing a spinulose or granular postcervical carapace. Of these, it most closely resembles *A. polyacantha* (Miyake *et* Sakai, 1967) from the East China Sea. *A. formosa* differs from the earlier described species in having fewer denticles on the anterolateral carapace; fewer spines along the cervical carina; the postcervical carapace granular rather than spinulose; a more slender smaller chela; more (ten to eleven against seven) dorsal dactylar spines in the larger chela; and in having fewer spinules on the distolateral surface of the meri of the first pereopods.

Acanthaxius grandis n.sp.

(Figs 1B, 3, 4)

Material examined. — **Tong-Kong.** Ping Tong County, south-western coast, sandy mud, about 400 m, 5.VIII.1996: holotype ♂ cl 33,5 mm (NTOU H-1996-8-5).

Paratype, Tong-Kong, Ping Tong County, south-western coast, about 400 m, 5.VIII.1996: ♂ cl 34.0 mm, lacking left pereopod 1 (USNM 253356). — Su-Aou, I-Lan County, north-eastern coast, sandy mud bottom, about 350 m, 1996: 1 ♂ cl 38.4 mm, 1 ♀ cl 39.6 mm (National Museum of Natural Science, Taiwan: 002701-00002). — Ta-Chi, I-Lan County, north-eastern coast, sandy mud bottom, about 350 m, 10.IV.1998: 1 ♂ cl 37.7 mm (NTOU P-1998-4-10).

Etymology. — The specific name refers to the large size of the animal. Along with *A. pilocheira*, at ≥ 34 mm carapace length, this is one of the larger *Acanthaxius* species.

Description

Carapace (Fig. 3A, B) with rosrrum reaching well beyond eyes, reaching to distal margin of antennal peduncle article 4, with one or two pairs of lateral spines, and pair of strong supraorbital spines at base; median carina well-marked, reaching onto base of rostrum, bearing six spines; submedian carina having four spines (excluding supraorbitals); lateral carina having two spines; cervical groove strong, reaching anteroventrally to hepatic region; postcervical carapace glabrous. Pleuron of abdominal somite 1 ventrally narrowly triangular; pleura 2-4 ventrally broadly rounded; pleuron 5 posteriorly rectangular; pleuron 6 with tiny ventral tooth (Fig. 3A). Telson (Fig. 3C) slightly wider than long, with tiny posteromedian tooth, tiny movable posterolateral tooth, and two pairs of stronger dorsal spines.

Acicle of antenna slender, reaching distally to distal margin of peduncle article 4. Pereopod 1, larger cheliped (Fig. 4A), merus with eight spines on ventral margin, three spines on dorsal margin, and scattering of spines on distolateral surface; carpus with four to six spines on dorsal margin, scattered spines on lateral surface; propodus with four strong spines on dorsal margin, ventral margin bearing row of forwardly-directed, sometimes overlapping spines running onto ventral fixed finger, lateral surface with numerous scattered spines, fixed finger with lateral row of spines basally, becoming tubercles distally; dactyl having eleven to twelve spines on dorsal margin, five spines on proximolateral surface; cutting margins of both fingers bearing rounded tubercles. Pereopod 1, smaller cheliped (Figs 3D, 4B), merus with seven spines on ventral margin, three to four spines on dorsal margin, with several scattered spines on distolateral surface; carpus with six to seven spines on dorsal margin and several spines on lateral surface; propodus with three to four spines on dorsal margin, ventral

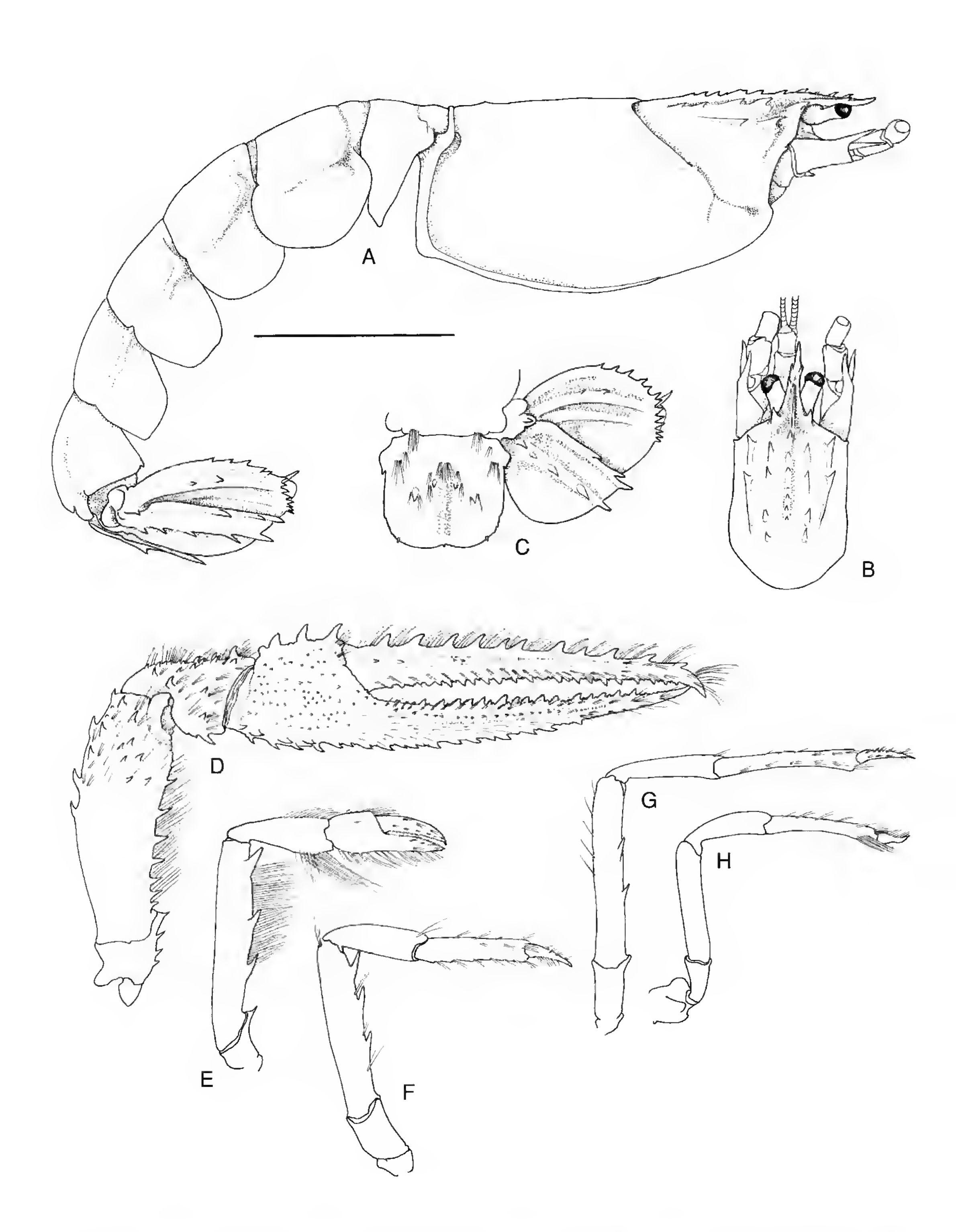


FIG. 3. — *Acanthaxius grandis* n.sp., paratype; **A**, lateral view; **B**, anterior carapace in dorsal view; **C**, telson and right uropod; **D**, pereopod 1, smaller cheliped, setae omitted; **E**, pereopod 2; **F**, pereopod 3; **G**, pereopod 4; **H**, pereopod 5. Scale bar: 20 mm.

margin consisting of row of distally-directed sometimes overlapping spines running onto fixed finger, lateral surface with numerous scattered spines, fixed finger with lateral row of spines becoming small tubercles distally; dactyl having eleven spines on dorsal margin, lateral row of spines becoming obsolete distally; cutting margins of both fingers having numerous alternating large and small acute teeth. Pereopod 2, merus with three strong teeth on ventral margin. Pereopod 3, merus with three teeth on ventral margin. Pereopod 4, merus with two teeth on ventral margin. Pereopod 5, merus unarmed. Uropodal lateral ramus having five to six spines along lateral margin, seven to eight spines along suture line, with a slender movable spine at junction, outer dorsal ridge bearing two spines; mesial ramus with three spines on lateral margin, five spines on dorsal ridge.

Colour: body orange, ventrally lighter; legs orange-red. Eyes dark brown.

REMARKS

Of the five species of *Acanthaxius* that possess a glabrous postcervical carapace, the present species closely resembles *A. pilocheira* (Sakai, 1987) from Japan, especially in the relatively large size (≥ cl 34.0 mm in both). Several differences, however, can be seen between the two species. The antennal acicle is relatively longer in the new species; in the larger cheliped of pereopod 1, *A. pilocheira* has eight to ten dorsal dactylar spines, *A. grandis* has eleven; in the smaller, more slender cheliped of pereopod 1, the proportion of finger length to lateral propodus length differs (2.0 in *A. pilocheira*, 2.5 in *A. grandis*); in the uropod, there are more marginal spines (eight to ten) and more suture spines (nine to ten) on the lateral ramus of the earlier described species, than in the present species (five, eight), while the mesial ramus has three marginal spines (as opposed to four in the earlier described species). There are also differences in the shape of the

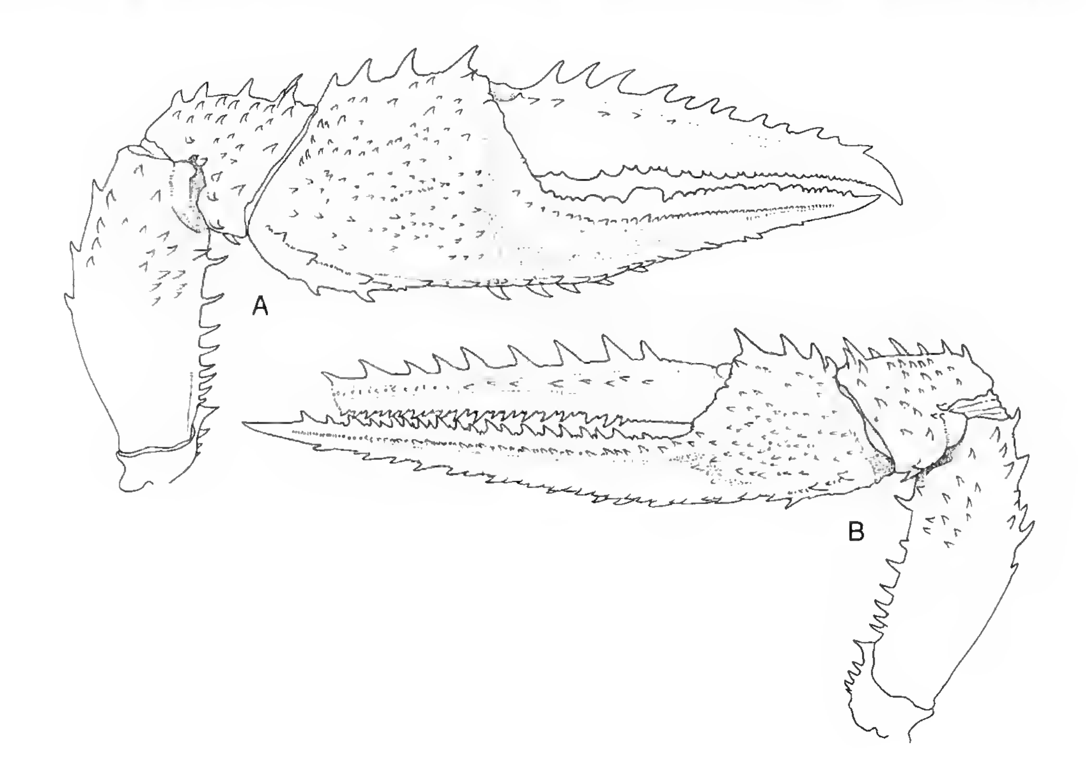


FIG. 4. — *Acanthaxius grandis* n.sp. holotype; **A**, pereopod 1, larger cheliped, setae omitted; **B**, pereopod 1, smaller cheliped, setae omitted.

abdominal pleura, especially pleuron 5 in the new species, which is posteriorly rectangular, rather than rounded as in *A. pilocheira*. While it is possible that these differences merely reflect a range of variation in a single species, they are certainly comparable to differences between species in other axiid genera.

Family CALOCARIDIDAE Ortmann, 1891
Genus *Calastacus* Faxon, 1893

Calastacus crosnieri n.sp.
(Figs 1C, 5)

MATERIAL EXAMINED. — **Ta-Chi.** I-Lan County, north-eastern coast, sandy mud bottom, 350 m, 10.VI.1993: holotype hermaphrodite cl 13.0 mm (NTOU H-1993-6-10).
Paratypes: all from Ta-Chi, I-Lan County, north-eastern coast, sandy mud botiom, 350 m, 9.IX.1986: hermaphrodite cl 10.5 mm (NTOU P-1986-9-9). — 21.V.1988: hermaphrodite cl 11.3 mm (NTOU P-1988-5-21). — 22.VI.1989: hermaphrodite cl 11.5 mm (NTOU P-1989-6-22). — 27.V.1992: hermaphrodite cl 8.9 mm (NTOU P-1992-5-27). — 10.VI.1993: hermaphrodite cl 12.2 mm (NTOU P-1993-6-10). — 27.V.1994: 2 hermaphrodites cl 9.7 mm, 10.5 mm (NTOU P-1994-5-27). — 3.VII.1995: hermaphrodite cl 10.6 mm (NTOU P-1995-7-3). — 19.X.1995: 5 hermaphrodites cl 9.6-12.9 mm, 1 ovigerous hermaphrodite cl 11.3 mm (NTOU P-1995-10-19). — 19.VII.1996: ovigerous hermaphrodite cl 8.9 mm (NTOU P-1996-7-19). — 17.IV.1998: 4 hermaphrodites cl. 10.0-14.0 mm, 1 ovigerous hermaphrodite cl. 11.0 mm (NTOU P-1998-4-17). — 10.VI.1993: hermaphrodite cl. 10.0 mm (USNM 253355).

ETYMOLOGY. — The species is named with much gratitude for Dr. Alain Crosnier, esteemed colleague and carcinologist *par excellence*.

DESCRIPTION

Carapace (Fig. 5A, B) somewhat inflated, glabrous; cervical groove dorsally faintly indicated; rostrum spiciform, dorsally grooved, with strong supraocular spine at base; median carina weakly indicated, rounded, strongest at base of rostrum. Pleuron of abdominal somite 1 triangular, ventrally subacute. Pleura 2-6 ventrally broadly rounded (Fig. 5A). Telson (Fig. 5C) 1.7 times longer than basal width, having single tiny posterolateral movable spine on each side, posterior margin evenly convex.

Eyes rounded, unpigmented, not contiguous. Acicle of antenna slender, acute, reaching midlength of penultimate peduncular article. Pereopod 1 (Fig. 5G), chelipeds subequal, ischium bearing five ventral spines; merus with nine to ten spines on ventral margin, single distal spine on dorsal margin; carpus unarmed; propodal palm with single distal tooth on carinate dorsal margin; fingers 0.7 times length of propodal palm. Pereopods 2-5 (Fig. 5H-K) unarmed, pereopod 4 longest. Pleopod 1 (Fig. 5E), distal article broad, mesial margin sinuate with fused basal lobe bearing tiny hooks. Pleopod 2 (Fig. 5F), exopod slender, flagelliform; endopod of single article, followed by biarticulate appendix masculina, latter with distal article longest, both articles bearing dense band of stiff setae becoming shorter distally, appendix interna fused basally with appendix masculina. Uropodal lateral ramus having nine spines along distal oblique-transverse suture, movable spine at junction of lateral margin and suture; mesial ramus with single distal spine on lateral margin (Fig. 5C).
Colour: body and eyes uniformly golden yellow.

REMARKS

The present material agrees well with the definition of *Calastacus*, provided by both de Saint Laurent (1972) and Kensley (1989), especially in the structure of pleopods 1 and 2.

Kensley (1996, table 2) compared the four known species of *Calastacus* on the basis of six characters. For these six characters, *C. crosnieri* has the following traits: the eyes are rounded and non-contiguous; pereopod 1, the dorsal margin of the merus has a single spine, the dorsal margin of the carpus is unarmed, the lateral surface of the propodus is unarmed; the mesial uropodal ramus has a single marginal spine; the lateral uropodal ramus has seven spines along the suture. All of these features are shared with *C. laevis* de Saint Laurent, 1972 from the eastern Atlantic. However, several differences separate these two species: the merus of pereopod 1 in the Atlantic species is armed with five spines on the ventral margin, ten in the Taiwanese species; the ischium bears three ventral spines in *C. laevis*, five in the

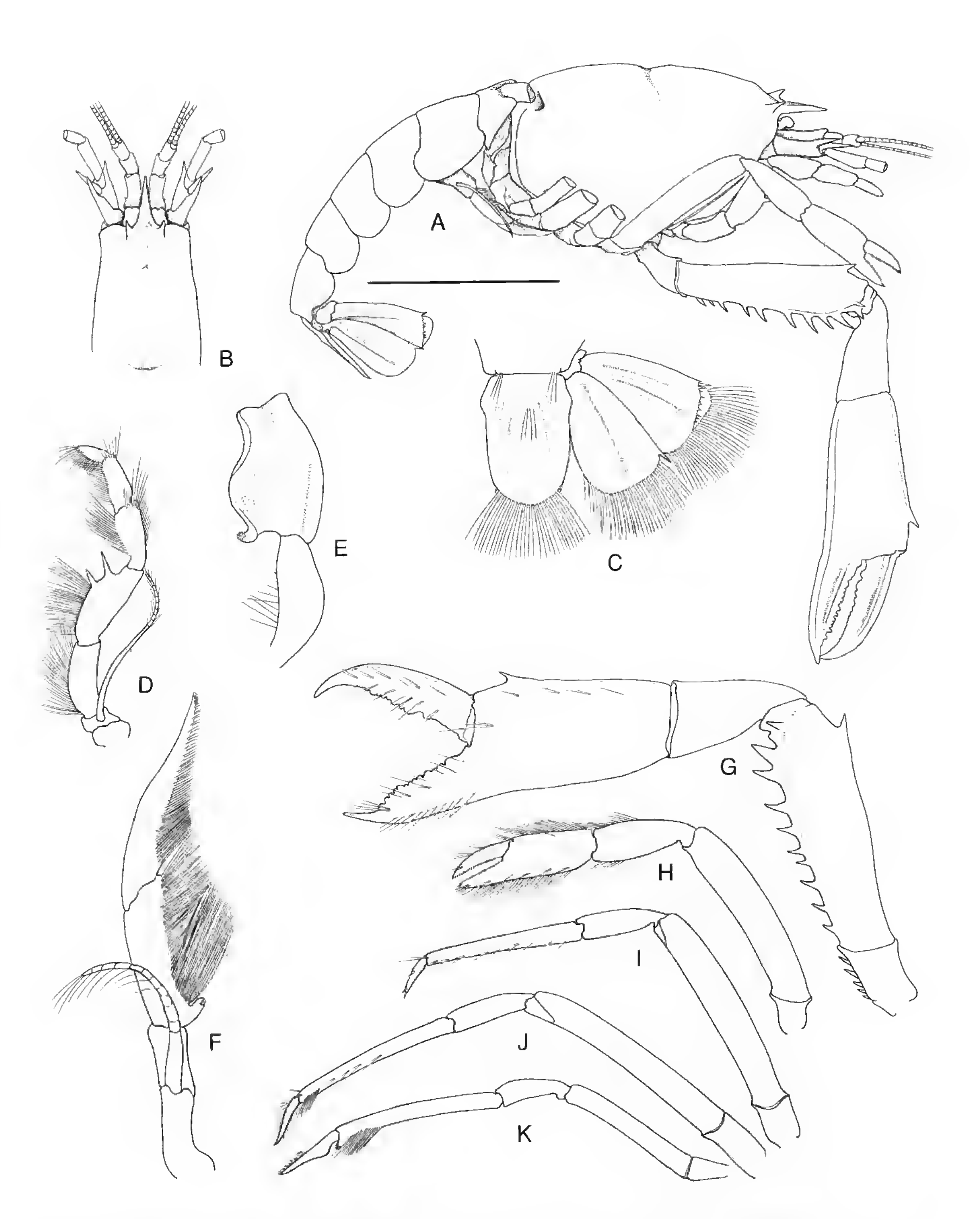


Fig. 5. — *Calastacus crosnieri* n.sp.; **A**, lateral view; **B**, anterior carapace in dorsal view; **C**, telson and right uropod; **D**, maxilliped 3; **E**, pleopod 1; **F**, pleopod 2; **G**, pereopod 1; **H**, pereopod 2; **I**, pereopod 3; **J**, pereopod 4; **K**, pereopod 5. Scale bar: 10 mm.

present species; pleopod 1 is distally more produced in the earlier species; the antennal peduncle reaches further beyond the antennular peduncle in the present species; the cervical groove of the carapace is more clearly defined in the earlier species. As only one specimen of *C. laevis* is known, and twenty two of the present species, conclusions based on size may not mean much, but *C. laevis* has a carapace length of 14.5 mm, while the present perhaps smaller species ranges from 8.9-14.0 mm.

Two of the specimens (cl 8.9 mm, 11.3 mm) are ovigerous. Eggs are about 0.5 mm in diameter, reaching 0.9 mm in diameter when close to hatching.

Acknowledgements

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ABSTRACT
Hermit crab specimens, previously assigned to *Pagurus gracilipes* (Stimpson, 1858) from the northwestern Pacific, have been critically reexamined. Examination of specimens from various localities from Japan and Russian Far East, has disclosed that males possess a short sexual tube on the right coxa of the fifth pereopod, and that two species have been synonymized under the name *Pagurus gracilipes*. The two taxa are provisionally transferred to the genus *Parapagurodes* McLaughlin *et* Haig, 1973. *Parapagurodes gracilipes* is redescribed on the basis of the specimens from northern Japan and Russian Far East, including topotypic material from Hakodate Bay, southern Hokkaido. *Parapagurodes nipponensis* (Yokoya, 1933), which has been considered to be synonymous with *P. gracilipes*, is reinstated for specimens from the Pacific coast of central and southwestern Japanese main islands, from Kashima, Ibaraki to Tosa Bay and Taiwan. The two species are for the most part geographically separated, though their distributions partly overlap. A neotype is designated for *P. gracilipes*, and a lectotype is selected for *P. nipponensis*. In addition, a new species of the genus *Pagurus*, *P. alaini*, is described and illustrated on the basis of material from Tosa Bay and Bungo Strait, Japan. The new species appears closest to *P. kaiensis* McLaughlin, 1997, known only from Kai Islands, Indonesia.

KEY WORDS
Crustacea, Decapoda, Anomura, Paguridae, *Parapagurodes*, *Pagurus*, northwestern Pacific, taxonomy.

RÉSUMÉ

Statut systématique de Pagurus gracilipes *(Stimpson, 1858) et* Pagurus nipponensis *(Yokoya, 1933), et description d'une nouvelle espèce de* Pagurus *(Decapoda, Anomura, Paguridae) du Japon.* Les pagures du nord-ouest du Pacifique auparavant attribués à *Pagurus gracilipes* (Stimpson, 1858) ont été réexaminés de façon critique. L'examen de spécimens de différentes localités du Japon et de l'Extrême-Orient russe montre que les mâles possèdent un court conduit sexuel sur la coxa droite du cinquième péréiopode, et que deux espèces ont été confondues sous le nom *Pagurus gracilipes*. Les deux taxa sont provisoirement transférés dans le genre *Parapagurodes* McLaughlin *et* Haig, 1973. *Parapagurodes gracilipes* est redécrit d'après les spécimens du nord du Japon et de l'Extrême-Orient russe, dont du matériel topotypique de la baie d'Hakodate au sud d'Hokkaido. *Parapagurodes nipponensis* (Yokoya, 1933), considéré comme synonyme de *P. gracilipes*, est rétabli pour les spécimens de la côte Pacifique des principales îles japonaises du centre et du sud-ouest, de Kashima (Ibaraki) jusqu'à la baie de Tosa et Taiwan. Dans l'ensemble, les deux espèces sont séparées géographiquement, bien que leurs aires de distribution se recoupent partiellement. Un néotype est désigné pour *P. gracilipes*, et un lectotype est choisi pour *P. nipponensis*. Une nouvelle espèce, *P. alaini*, est ajoutée au genre *Pagurus*, et décrite et figurée d'après du matériel de la baie de Tosa et du détroit de Bungo au Japon. La nouvelle espèce semble proche de *P. kaiensis* McLaughlin, 1997 connue seulement des îles Kai en Indonésie.

MOTS CLÉS.
Crustacea,
Decapoda,
Anomoura,
Paguridae,
Parapagurodes,
Pagurus,
nord-ouest Pacifique,
taxonomie.

INTRODUCTION

Stimpson (1858) described *Eupagurus gracilipes* from Hakodate Bay, southern Hokkaido, Japan, and later Doflein (1902) and Balss (1913) recorded the species from Sagami Bay. Subsequently, Yokoya (1933) described a number of new species of hermit crabs, among them *Eupagurus nipponensis*. The descriprion of this species was based on specimens collected from various locations in the Japanese main islands during a biological survey of the continental shelf of Japan made by S. S. *Soyo-Maru*. Yokoya was obviously unaware of Stimpson's description as he also described a new species which he named *Eupagurus gracilipes*, which proved to be a homonym of Stimpson's (1858) taxon. Makarov (1938) placed Yokoya's *E. nipponensis* in synonymy with Stimpson's *E. gracilipes*. Yokoya's *E. gracilipes* was renamed *Pagurus yokoyai* by Makarov (1938: 184-185; 1962: 175), and this has been followed by subsequent authors such as Miyake (1965; 1975; 1982), Miyake & Imafuku (1980), Takeda (1982) and Baba (1986).

During a taxonomic study of decapod Crustacea of northern Japan, I collected specimens clearly assignable to Stimpson's *Eupagurus gracilipes*, including topotypic material from Hakodate Bay. I noticed that the northern Japan specimens had apparently different colour patterns from those in the colour photographs of Miyake (1982) and Baba (1986) which depicted specimens from Kii Minabe and Tosa Bay. The northern specimens had two blue iridescent longitudinal lines on the right palm, and lacked brown and cream stripes on the lateral surfaces on the ambulatory propodi. Careful examination of material from various localities in Japan, the Russian Far East and Taiwan disclosed that male specimens bear a short sexual tube on the right coxa of the fifth pereopods, and that two species have been confounded under the name of *Pagurus gracilipes* (Stimpson). According to current definitions of pagurid genera, the two species cannot be assigned to *Pagurus*

Fabricius, 1775, but must instead be assigned to *Parapagurodes* McLaughlin & Haig, 1973.

The two species are geographically separated for the most part, though their distributions partly overlap. The species distributed in Hokkaido, northern Honshu southward to Choshi, Chiba, and Russian Far East is referred to *Parapagurodes gracilipes* (Stimpson), and the species distributed in the Pacific coast of central and southwestern Japanese main islands, from Kashima, Ibaraki to Kyushu and Taiwan is referred to *Parapagurodes nipponensis* (Yokoya). *Parapagurodes nipponensis* has a tendency to inhabit deeper water than *P. gracilipes*. As noted above, Stimpson's taxon originally came from Hakodate, southern Hokkaido. Yokoya's taxon was described on the basis of twenty-nine specimens collected during *Soyo-Maru* cruises around Japanese main islands (see "Remarks" under the account *Parapagurodes nipponensis*). The two species are distinguished morphologically from each other by the armament of the ambulatory dactyls and the shape of the posterior margin of the telson, in addition to the coloration. As was the case with many of Stimpson's species, the type material of *Pagurus gracilipes* apparently was destroyed (*cf.* Rathbun 1883). However, I was able to find a single lot containing two syntypes of *Eupagurus nipponensis* from south of Omae-zaki (*Soyo-Maru*, stn 278) in the collection of the Kitakyushu Museum of Natural History. My attempts to find other lots were not successful. Yokoya's type material of *E. nipponensis* contained specimens from Tsugaru Strait, very near to Hakodate Bay and from Inubo-zaki, Choshi, where the two species are likely to overlap. In the interest of stability in nomenclature, a neotype is herein designated for *P. gracilipes*, and the larger, more intact syntype specimen is selected as a lectotype of *P. nipponensis*. *Parapagurodes gracilipes* is fully described and illustrated, while brief diagnosis is given for *Parapagurodes nipponensis*, as the species is very similar to *P. gracilipes*.

In addition, I include here a description of a new species of *Pagurus*, *P. alaini*, from Tosa Bay and Bungo Strait, Japan. The new species shows some superficial resemblance to the *bernhardus* group of *Pagurus* (*cf.* Mclaughlin 1974), but it appears closest to *P. kaiensis* McLaughlin, 1997, known only from Kai Islands, Indonesia. At present no species-group assignment can be made for *P. alaini*, nor has one been made for *P. kaiensis*.





FIG. 1. — **A**, *Parapagurodes gracilipes* (Stimpson, 1858), entire animal, dorsal, ♂ SL 7.3 mm, Choshi, central Japan, CBM-ZC 3410; **B**. *Parapagurodes nipponensis* (Yokoya, 1933), ♂ SL 8.7 mm, Su-Aou, NE Taiwan, NTOU (photography by T.-Y. Chan).

The specimens examined in this study are deposited in institutions indicated by the following abbreviations:

CBM	Natural History Museum and Institute, Chiba;
HUMZ	Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University Hakodate;
KMNH	Kitakyushu Museum of Natural History;
MNHN	Muséum national d'Histoire naturelle, Paris;
NTOU	National Taiwan Ocean University, Keelung;
SMI-NSMT	Showa Memorial Institute, National Science Museum, Tsukuba;
USNM	National Museum of Natural History, Smithsonian Institution, Washington, D. C.

The general terminology used in the description is that of McLaughlin (1974), but Lemaitre (1995) is referred to for the posterior carapace structure. The term "semichelate" to describe the condition of the fourth pereopods is used following McLaughlin's (1997) definition. The shield length (SL), measured from the tip of the rostrum to the midpoint of the posterior margin of the shield, is used to indicate size of specimens.

SYSTEMATICS

Genus *Parapagurodes* McLaughlin *et* Haig, 1973

Parapagurodes gracilipes (Stimpson, 1858), comb. nov. (Figs 1A, 2-5, 7)

Eupagurus gracilipes Stimpson, 1858: 248; 1907: 217. – Alcock 1905: 177 (in part). – Yokoya 1939: 281. – Urita 1942: 45, fig. 14.

Pagurus gracilipes – Makarov, 1938: 184 (in part), pl. 4, fig. 4; 1962: 175 (in part), pl. 4, fig. 4. – Vinogradov 1950: 227 (in part), fig. 117. – Miyake 1957: 87 (in part); 1965: 647 (in part); 1975: 286 (in part); 1982: 126 (in part). – Igarashi 1970: 4, pl. 3, fig. 9. – Kim 1973: 222, fig. 48, pl. 5, fig. 28. – Takeda 1982: 68 (in part). – Komai *et al.* 1992: 197.

Not *Eupagurus gracilipes* – Doflein 1902: 647, pl. 6, figs 6-8. – Balss 1913: 56. – Terao 1913: 368. [= *Parapagurodes nipponensis* (Yokoya, 1933)].

Not *Eupagurus gracilipes* Yokoya, 1933: 98, fig. 33 [=*Pagurus yokoyai* Makarov, 1938].

Not *Pagurus gracilipes* – Miyake 1978: 85, fig. 33. – Miyake & Imafuku 1980: 59. – Baba 1986: 201, 303, fig. 149 [=*Parapagurodes nipponensis* (Yokoya, 1933)].

Type material. — **Japan.** Off Kamiiso, Hakodate Bay, southern Hokkaido, 5-10 m, 8.III.1991, dredge, coll. S. Goshima: neotype ovig. ♀ SL 5.1 mm (CBM-ZC 3414).

Material examined. — **Japan.** Obira, Japan Sea coast of Hokkaido, 44°00'N - 141°39'E, 20 m, 21.VII.1991, beam trawl, coll. S. Maruyama: 1 ovig. ♀ SL 5.7 mm (CBM-ZC 501). — Off Choshi, Chiba, *ca.* 20 m, 18.I.1995, commercial trawler, coll. T. Komai: 1 ♂ SL 7.0 mm, 1 ♀ SL 6.6 mm (CBM-ZC 941). — Off Choshi, Chiba, 10-20 m, 3.IX.1996, commercial trawler, coll. T. Komai: 2 ♂♂ SL 5.4, 9.0 mm, 1 ♀ SL 6.7 mm (CBM-ZC 2977). — Off Obira, Japan Sea coast of Hokkaido, 44°00'N - 141°39'E, 42 m, 19.VIII.1994, sledge net, coll. F. Muto: 4 ♂♂ SL 4.2-7.2 mm (CBM-ZC 3409). — Off Choshi, Chiba, 10-20 m, 10.I.1997, commercial trawler, coll. T. Komai: 1 ♂ SL 7.3 mm (CBM-ZC 3410). — Same data as neotype: 5 ovig. ♀♀ SL 5.5-6.0 mm (CBM-ZC 3415). — Miyako Bay, Iwate, *ca.* 15 m, IV.1987, gill net, coll. T. Komai: 3 ♂♂ SL 8.4-9.0 mm (HUMZ-C 79).
Russian Far East. Slednaya Bay, Prymorye, subtidal, 27.VIII.1994, beach seine, coll. M. Yabe: 1 ♂ SL 6.4 mm (CBM-ZC 2456).

Distribution. — Known with certainty from northern Japan including Hokkaido and northeastern Honshu main island southward to Choshi, Chiba (35°40'N), continental coast of the Russian Far East, Sakhalin, subtidal to 42 m.

Size. — Largest ♂: 9.0 mm in SL; largest ♀: 6.7 mm in SL; smallest ovigerous ♀: 5.5 mm in SL.

Habitat. — Found in gastropod shells; occasionally with one or more anthozoan polyps attached to the shell. Inhabiting sandy or sandy mud bottom, subtidal to a depth of 42 m.

Redescription

Shield (Fig. 2A) varying from slightly longer than broad to slightly broader than long; anterolateral margins sloping; anterior margin between rostrum and lateral projections concave; posterior margin rounded; dorsal surface convex, generally smooth, but with scattered tufts of moderately short setae. Rostrum distinctly exceeding lateral projections, triangular, acute or subacute, usually with small terminal spine. Lateral projections broadly rounded or obtusely triangular, with small terminal spine. Posterior carapace

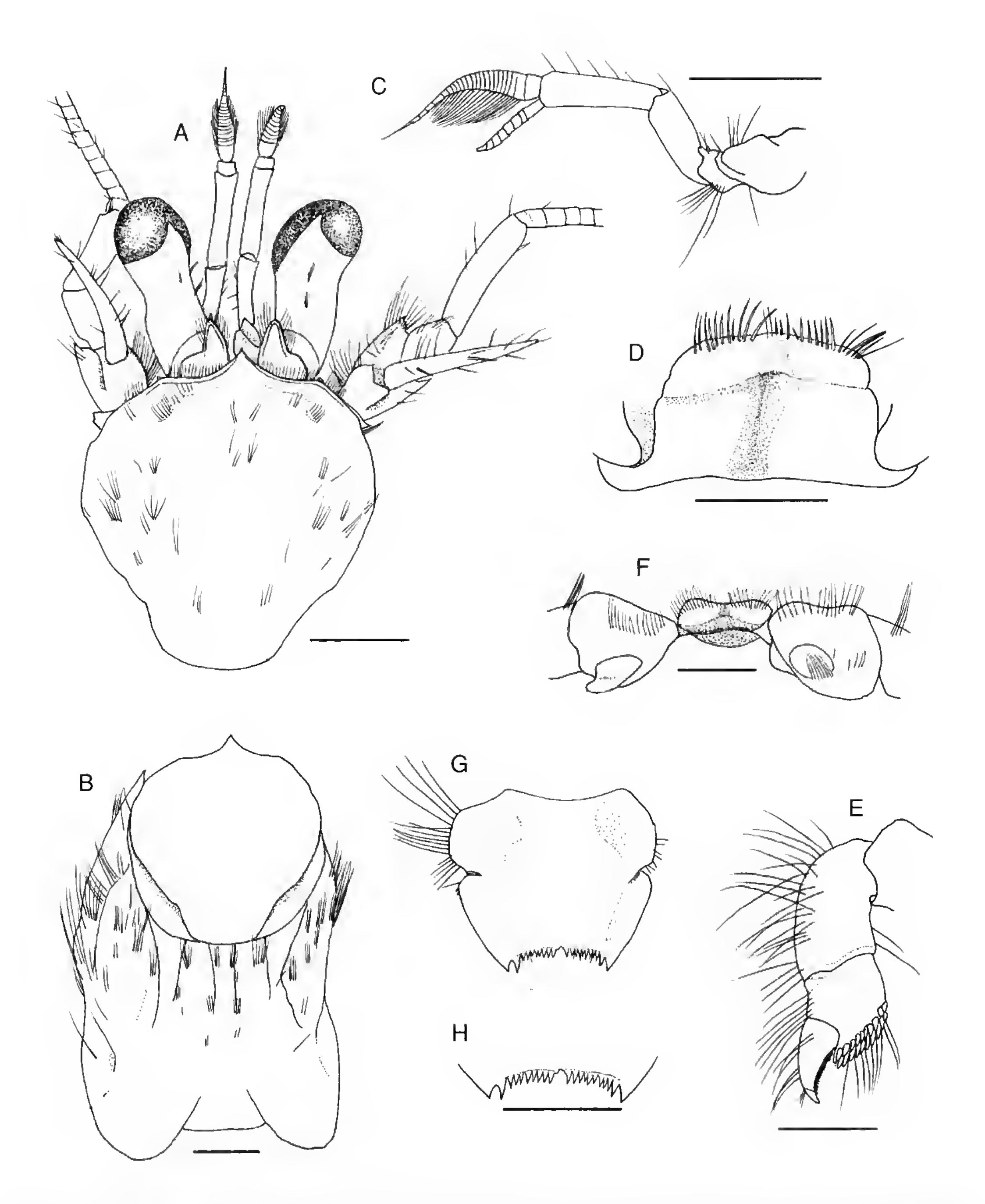


FIG. 2. — *Parapagurodes gracilipes* (Stimpson, 1858), A-E, G, H, neotype, ♀ SL 5.1 mm (CBM-ZC 3414), Hakodate Bay, southern Hokkaido, Japan; F, ♂ SL 9.0 mm (HUMZ-C 79), Miyako Bay, Tohoku district of Honshu, Japan; **A**, shield and cephalic appendages, dorsal; **B**, carapace, dorsal (setae on shield omitted); **C**, left antennule, lateral; **D**, sternal lobe of sixth thoracic somite, ventral; **E**, distal three segments of left fourth pereopod, lateral; **F**, coxae of fifth pereopods and sternal lobe of eighth thoracic somite, ventral; **G**, telson, dorsal; **H**, terminal margins of telson, dorsal. Scale bars: A-C, F, 2 mm; D, E, G, H, 1 mm.

(Fig. 2B) with scattered tufts of long setae dorsally; posteromedian plate calcified; cardiac sulci nearly parallel, not extending to posterior margin of carapace; sulci cardiobranchiales slightly divergent posteriorly, not extending beyond cardiac sulci.

Ocular peduncles (Fig. 2A) 0.6-0.7 times as long as shield, stout, weakly inflated basally, corneal region ovate, noticeably dilated; dorsomesial surface with longitudinal row of short setae. Ocular acicles subtriangular or subovate, mesial margins nearly straight or convex, lateral margins nearly straight, sometimes sinuous, dorsal surface concave, terminating roundly, usually with prominent submarginal spine.

Antennular peduncles (Fig. 2A, C) exceeding ocular peduncles by 0.5-0.7 length of ultimate segment; ultimate segment about 1.5 times longer than intermediate segment, with row of setae dorsally; basal segment stout, inflated ventrally and laterally, unarmed laterally.

Antennal peduncles (Fig. 2A) exceeding ocular peduncles by 0.5-0.75 length of fifth segment; with supernumerary segmentation. Fifth segment unarmed, with few setae on mesial surface. Third segment with ventromesial distal angle produced, terminating in prominent spine, partially obscured by tufts of moderately long setae. Second segment with dorsolateral distal angle produced, terminating in simple or bifid spine, mesial margin with few small spines; dorsomesial distal angle with small spine, mesial surface with numerous setae. First segment with or without small spine at laterodistal margin. Antennal acicle arcuate, slightly shorter to somewhat longer than ocular peduncle, nearly reaching or distinctly overreaching distal corneal margin, sharply edged mesially, dorsal surface flattened, mesial margin unarmed, but with tufts of setae. Antennal flagella long, simple.

Mandible (Fig. 3A) typical of genus. Maxillule (Fig. 3B) with proximal endite subquadrate; endopod with one or two bristles on well developed, broadly based internal lobe, external lobe produced, recurved toward interior. Maxilla (Fig. 3C) with endopod inflated basally, extending beyond distal margin of scaphognathite. First maxilliped (Fig. 3D) with endopod extending as far as distal margin of distal endite. Second maxilliped (Fig. 3E) with basis-ischium fusion incomplete. Third maxilliped (Fig. 3F) with basis-ischium fusion incomplete; basis (Fig. 3G) with strong, corneous tipped spine mesially; crista dentata on ischium (Fig. 3G) composed of relatively stout spines, becoming more slender and closer distally, accessory tooth strong; merus usually with acute spine on dorsodistal margin; carpus with dorsodistal margin unarmed.

Right cheliped (Figs 3H, 4A, B) moderately (small specimens) to considerably (large specimens) elongate. Chela 1.8-2.0 times as long as wide, dorsolateral margin convex. Dactyl approximately equalling length of palm; cutting edge with row of four strong calcareous teeth in proximal 0.75 length and with row of small corneous teeth subdistally, terminating in strong calcareous tooth, overlapped by fixed finger; dorsomesial margin sharply ridged, tuberculate proximally, dorsal surface with sharp ridge mesially, sometimes weakly tuberculate proximally; ventral surface with several tufts of stiff setae. Cutting edge of fixed finger with row of low calcareous teeth and of small corneous teeth subdistally, terminating in calcareous claw. Palm slightly shorter than carpus; dorsal surface convex, with small granules or spinulose tubercles, occasionally arranged in transverse rows, making surface rugose, almost naked; dorsomesial surface weakly elevated, sloping to mesial surface, with larger, flattened tubercles, occasionally multifid distally; dorsolateral margin with row of moderately strong spines or tubercles increasing in size distally; lateral surface with numerous low, occasionally bifid or multifid tubercles and granules; ventral surface with few tubercles. Carpus subequal in length to merus; dorsal surface convex, with numerous scattered spines or spinulose, frequently bifid or multifid tubercles and distinct row of spines mesiad to mid-line, distal margin denticulate, dorsomesial margin with row of strong, acute or subacute spines, increasing in size distally; dorsolateral surface sloping to lateral surface; mesial surface with few low tubercles dorsally; lateral surface with scattered short oblique rows of small spines or tubercles and granules; ventral surface with few small acute or subacute spinulose tubercles.

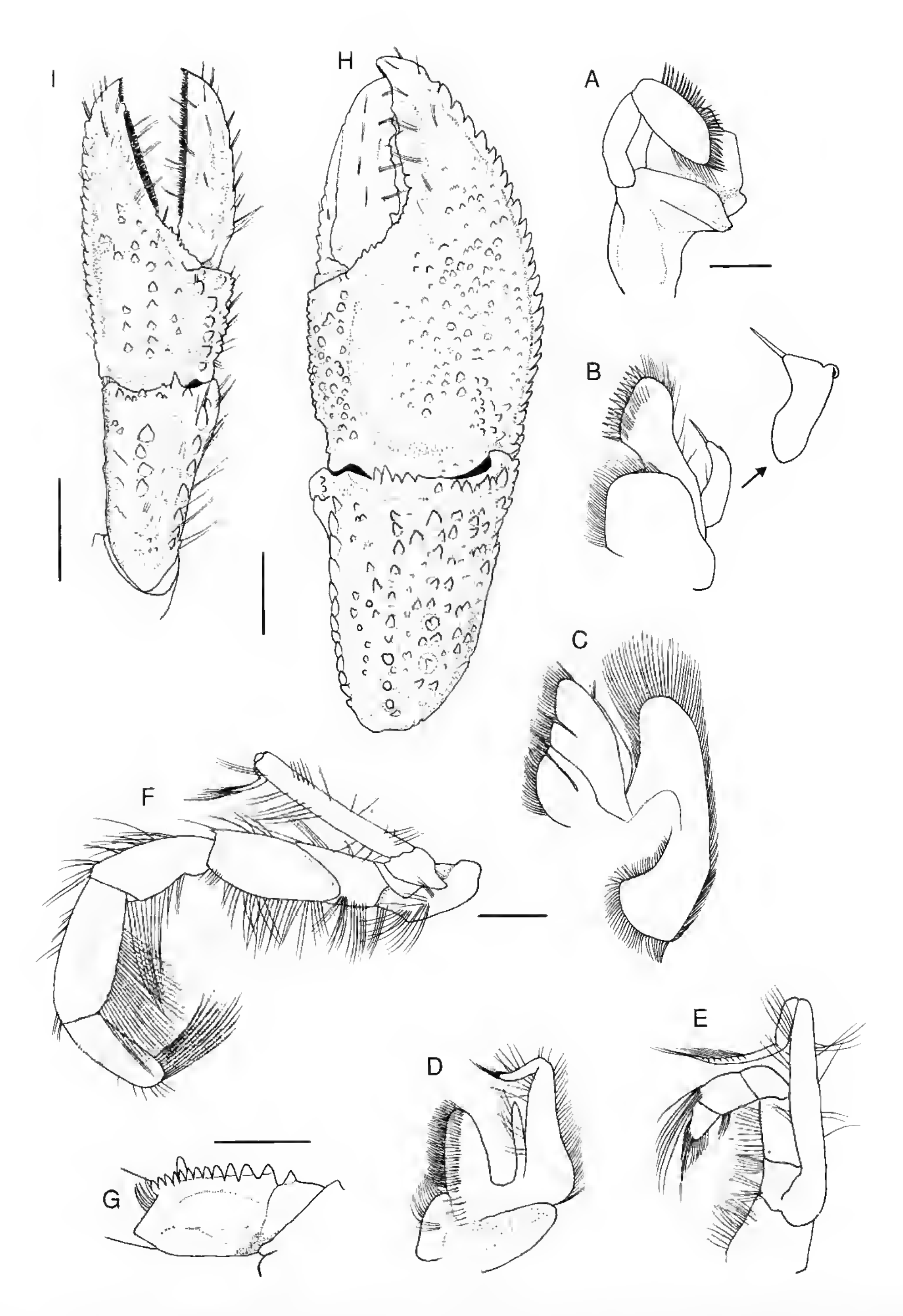


FIG. 3. — *Parapagurodes gracilipes* (Stimpson, 1858), neotype, ♀ SL 5.1 mm (CBM-ZC 3414), Hakodate Bay, southern Hokkaido, Japan; left mouthparts; **A**, mandible, internal; **B**, maxillule, external; inset, endopod, lateral; **C**, maxilla, external; **D**, first maxilliped, external; **E**, second maxilliped, external; **F**, third maxilliped, lateral (external); **G**, ischium of third maxilliped, dorsal (internal); **H**, chela and carpus of right cheliped, dorsal; **I**, chela and carpus of left cheliped, dorsal. Scale bars: A, B, 0.5 mm; C-G, 1 mm; H, I, 2 mm.

Merus with dorsal surface having transverse multidenticulate ridges and row of short setae or bristles, distal margin with several small or moderately strong, acute spines, extending laterally and mesially; lateral and mesial faces almost smooth dorsally, with short vertical granular ridges ventrally; ventral surface spinulose or tuberculate. Ischium with row of small spines or denticles and tufts of setae on ventromesial margin, ventrolateral margin with few small spines or tubercles. Coxa with few small spines at ventrolateral distal angle; ventromesial margin with dense tufts of stiff setae.

Left cheliped (Figs 3I, 4C, D) reaching distal margin of carpus or mid-length of palm of right cheliped. Chela 1.9-2.2 times longer than wide, widest at base of dactyl, dorsolateral margin slightly convex or nearly straight. Dactyl approximately twice length of palm; dorsomesial margin convex, with row of low protuberances or small tubercles and row of tufts of stiff setae, dorsal surface sometimes with row of small tubercles proximally; mesial and ventral surfaces nearly smooth, but with scattered tufts of stiff setae; cutting edge with row of closely set corneous teeth and few obtuse calcareous teeth, terminating in small corneous claw, slightly exceeded in length and overlapped by fixed finger. Cutting edge of fixed finger with row of closely set corneous teeth, terminating in small corneous claw. Palm with dorsolateral and dorsomesial margins weakly elevated, with single row of simple spines or spinulose tubercles, dorsal surface with several rows of moderately strong spines or spinulose tubercles; mesial and lateral surfaces nearly smooth, with few low protuberances and tufts of stiff setae; ventral surface with small, occasionally spinulose tubercles and tufts of short setae. Carpus subequal in length to merus; dorsal surface oblique, dorsomesial margin with single row of strong spines, dorsolateral surface with short submedian row of prominent spines or spinulose tubercles and laterally with obliquely vertical multifid protuberances bearing bristles, distal margin strongly spinous; mesial surface slightly concave, with few low protuberances bearing setae and scattered tufts of moderately long setae, ventromesial margin minutely tuberculate distally; ventral surface nearly smooth. Merus triangular in cross-section; dorsal surface with transverse, multidenticulate ridges bearing long setae, distal ones extending to mesial surface, distal margin with one prominent spine obscured by setae; mesial face nearly smooth, with few tufts of short setae dorsally, distal margin unarmed; lateral face with few short, vertical ridges distally and scattered setae, distal margin unarmed; ventral surface with multidenticulate tubercles, ventromesial and ventrolateral margins each with row of small, simple or multifid tubercles and short setae. Ischium with row of simple or bifid spines on ventromesial margin, ventrolateral margin with row of small spinulose tubercles. Coxa similar to that of right cheliped.

Ambulatory pereopods (Fig. 5A, D) long; right second pereopod often overreaching tip of right chela. Dactyls (Fig. 5B, C) 1.32-1.53 times longer than propodi in second pair, 1.38-1.64 times longer in third pair, relatively broad; in lateral view, weakly or moderarely curved ventrally; in dorsal view, strongly twisted; dorsal surfaces each with shallow longitudinal sulcus proximally and row of moderately small spines laterad to sulcus, continuous with acute subdistal ridge bearing bristles; lateral and mesial surfaces each with prominent longitudinal sulcus, accompanied proximally with deep depression; mesial surfaces each with rows of small corneous spines on either side of sulcus and with tufts of stiff setae ventrally; ventral margins weakly sinuous, each with twenty-six to forty-one spinules, becoming more closely-set distally. Propodi distinctly longer than carpi; dorsal surfaces each with irregular rows of simple or multidenticulate spines, distal margins each with few small spines; lateral surfaces each with obliquely vertical, multidenticulate protuberances bearing short setae dorsally and few bidenticulate small tubercles ventrally, distal margins denticulate; mesial surfaces each with scattered bidenticulate tubercles; ventral surfaces each with small tubercles and tufts of short setae. Carpi much shorter than meri; dorsal surfaces each with single or double row of strong, simple or multifid spines, increasing in size distally; lateral surfaces each with prominent denticulate ridge bearing short setae and multidenticulate protuberances or tubercles dorsally, surfaces ventrad to ridge nearly smooth; mesial surfaces near-

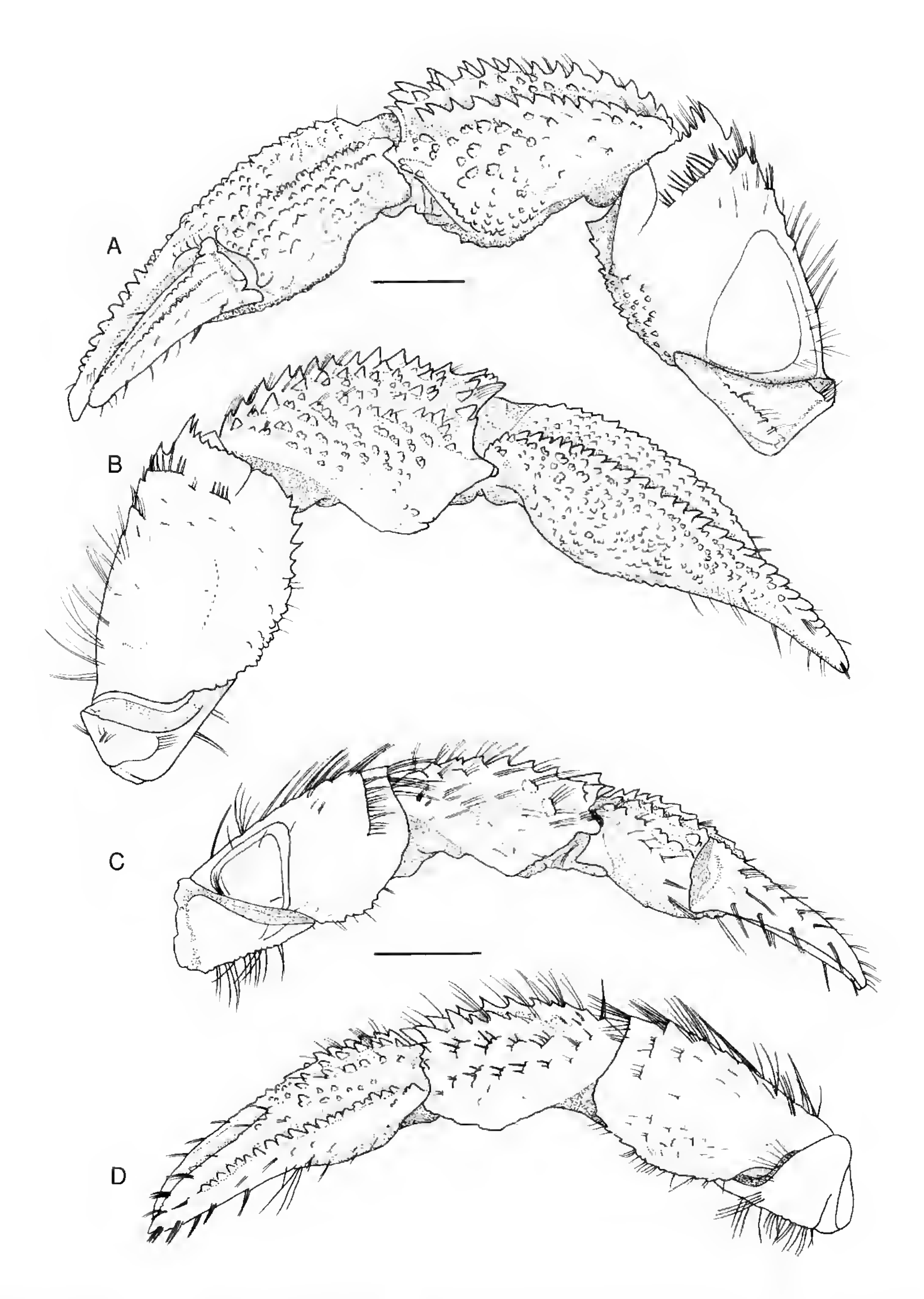


FIG. 4. — *Parapagurodes gracilipes* (Stimpson, 1858), neotype, ♀ SL 5.1 mm (CBM-ZC 3414), Hakodate Bay, southern Hokkaido, Japan; **A**, right cheliped, mesial; **B**, same, lateral; **C**, left cheliped, mesial; **D**, same, lateral. Scale bars: 2 mm.

ly smooth, each with few simple or bifid small tubercles dorsally; ventral surfaces smooth. Meri with convex dorsal and ventral margins, those of second pereopods relatively broad; dorsal surfaces each with strong, transverse, multidenticulate ridges bearing bristles (ridges less developed in left third pereopod), mesial margins delimited except for left third pereopod, with row of long setae and few small spines; lateral surfaces nearly smooth, with few tufts of minute setae; mesial surfaces nearly smooth, with few simple or bifid tubercles near ventral margins except for left third pereopod; ventral margins each with irregular rows of simple or multidenticulate spines in second pair and right third, nearly smooth in left third. Ischia of second pair with small tubercles on ventral surfaces, third pair with ventral surfaces unarmed; dorsal and ventral surfaces each with tufts of setae. Coxae unarmed; females with paired gonopores. Anterior sternal lobe on sixth thoracic somite (Fig. 2D) proportionally broad, subquadrate, weakly skewed, sulcate medially, with stiff setae on anterior surface.

Fourth pereopods (Fig. 2E) setose, semichelate.

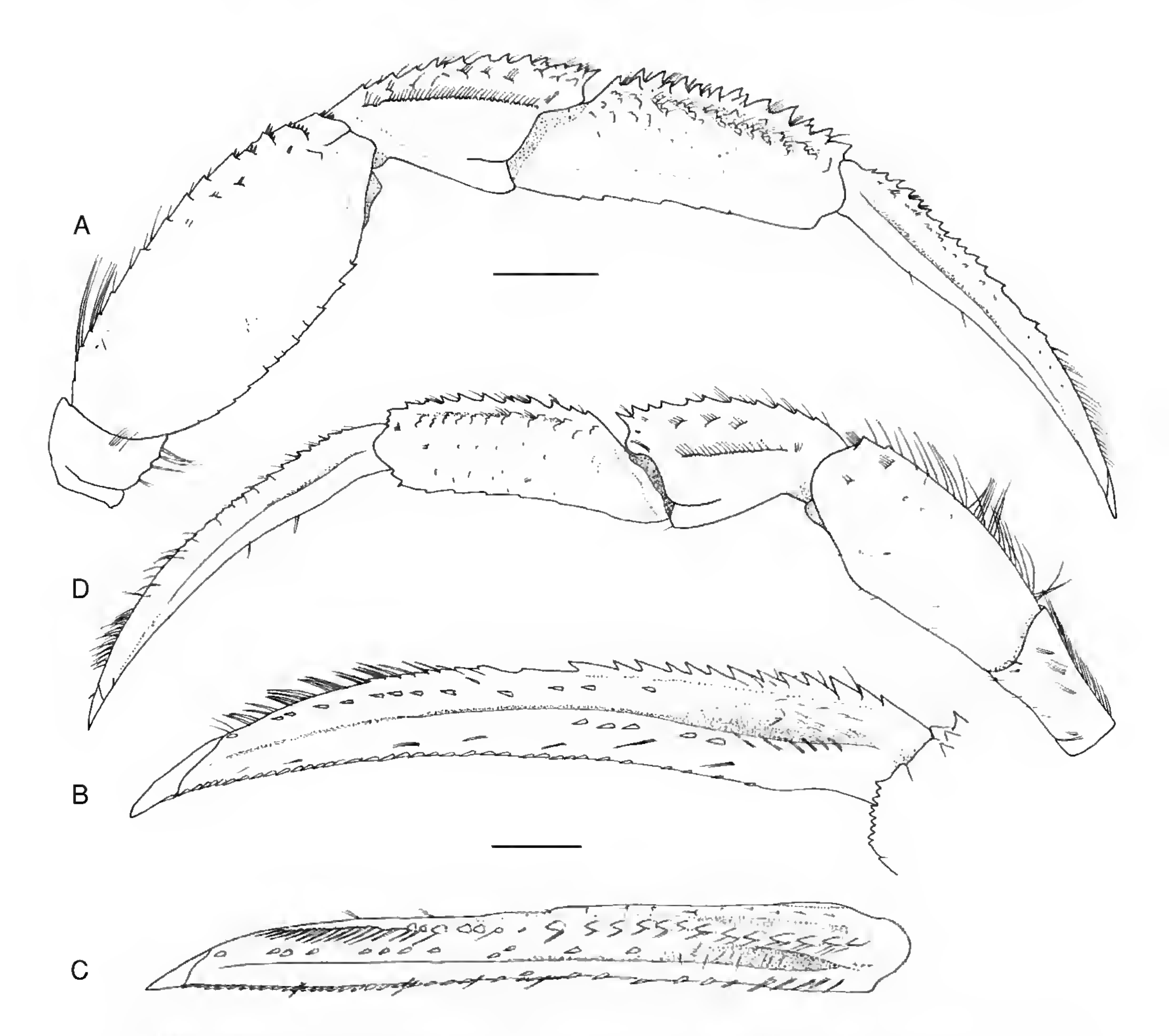


Fig. 5. — *Parapagurodes gracilipes* (Stimpson, 1858), neotype, ♀ SL 5.1 mm (CBM-ZC 3414), Hakodate Bay, southern Hokkaido, Japan; **A**, right second pereopod, lateral; **B**, same, dactyl, mesial; **C**, same, dorsal; **D**, left third pereopod, lateral. Scale bars: A, D, 2 mm; B, C, 1 mm.

Dactyl curved, without preungual process. Propodal rasp composed of several rows of corneous scales.

Fifth pereopods chelate. Right coxa (Fig. 2F) of males with short sexual tube, sometimes curved posteriorly; left coxa with gonopore encircled posteriorly by row of setae, no sexual tube.

Sternite of eighth thoracic somite (Fig. 2F) developed anteriorly as two subovate lobes separated by shallow median groove, anterior margins each with tuft of dense setae.

Abdomen with three unequally biramous unpaired pleopods on third to fifth somites in males, with exopods moderately well-developed, endopods strongly reduced; with four unpaired pleopods in females, second to fourth pleopods with both rami well-developed, fifth pleopod with exopod well-developed, endopod noticeably reduced.

Uropods strongly asymmetrical. Telson (Fig. 2G) with posterior lobes nearly symmetrical, lateral margins oblique, occasionally with spinules proximally at least on left side; posterior margin (Fig. 2H) with indistinct or very small median cleft, each terminal margin nearly horizontal, eight to ten small spines and two or three stronger spines at posterolateral angle; transverse incision moderately deep.

Eleven pairs of phyllobranchiae.

COLORATION

In life: shield mottled or reticulated with brown and cream, anterior margins between rostrum and lateral projections reddish. Posterior carapace mottled reddish brown. Ocular peduncles with base colour gray-brown, reticulated basally, becoming darker toward corneal base, with row of four dark brown spots on dorsomesial surfaces. Antennular peduncles mottled brown, few dark brown spots on distal segment. Antennal peduncles mottled or reticulated with grey-brown, with tinge of red at articulations of each segment. Merus of third maxilliped with strong iridescence on dorsal surface. Palm of right cheliped generally brown, paler laterally and mesially, with two longitudinal lines of blue iridescence on dorsal surface, confluent distally and extending onto basal part of fixed finger; palm of left cheliped with blue iridescence medially; spines, tubercles or protuberances on both palm dark brown; carpi of both chelipeds generally pale yellowish brown, with spines or tubercles darker; meri generally pale yellowish brown, becoming darker distally, protuberances dark brown. Dactyls of ambulatory pereopods with three dark grey and two cream stripes on lateral surface, becoming obscure distally; propodi grey-brown generally, with tinge of cream or yellowish brown dorsodistally, ventrolateral to ventral surface pale yellowish brown or cream; carpi grey-brown generally, lateral surface ventral to granular ridge appearing as dark grey line with tinge of reddish brown, tubercles and dorsal row of spines dark brown; meri mottled or reticulated with yellowish brown, becoming darker distally, with spots of dark brown on lateral surfaces, dorsal protuberances dark brown.

In preservative: faded into straw colour entirely.

REMARKS

There is a marked variation in growth of the chelipeds, with those of larger specimens becoming elongate and more slender with increasing body size. The shape of the ocular acicles varies from subtriangular to semiovate.

Parapagurodes nipponensis (Yokoya, 1933), comb. nov.
(Figs 1B, 6, 7)

Eupagurus gracilipes – Doflein 1902: 647, pl. 6, figs 6-8. – Balss 1913: 56. – Terao 1913: 368. Not *Eupagurus gracilipes* Stimpson, 1858.

Eupagurus gracilipes – Alcock 1905: 177 (in part).

Eupagurus nipponensis Yokoya, 1933: 87 (? in part), fig. 32.

Pagurus gracilipes – Makarov 1938: 184 (in part); 1962: 175 (in part). – Vinogradov 1950: 227 (in part), fig. 117. – Miyake 1965: 647 (in part), fig. 1093; 1975: 286 (in part), pl. 116, fig. 5; 1982: 126 (in part), pl. 42, fig. 5. – Takeda 1982: 68 (in part).

Pagurus gracilipes – Miyake 1978: 85, fig. 33. – Miyake & Imafuku 1980: 59. – Baba 1986: 201, 303, fig. 149. Not *Pagurus gracilipes* (Stimpson, 1858).

TYPE MATERIAL. — **Japan.** South of Omae-zaki, Shizuoka, *Soyo-Maru*, stn 278, 79 m, 2.VII.1927: lectotype (herein selected) ♂ SL 8.0 mm (KMNH). —

Same lot: paralectotype ovig ♀, fragmented (KMNH).

MATERIAL EXAMINED. — **Japan.** Off Kashima, Ibaraki, 35°55.8'N - 140°54'E, 65 m, 24.IV.1991, commercial trawler: 2 ♂♂ SL 8.0, 9.2 mm (CBM-ZC 50). — Off Choshi, Chiba, 65 m, 8.V.1991, commercial trawler: 1 ♂ SL 8.4 mm (CBM-ZC 51). — Off Choshi, *ca.* 60 m, 18.VI.1991, commercial trawler: 3 ♂♂ SL 8.0-10.4 mm (CBM-ZC 54). — Off Choshi, 35°45'N - 140°58'E, 60 m, 21.X.1991, commercial trawler: 1 ovig. ♀ SL 7.2 mm (CBM-ZC 60). — Off Kochi, Tosa Bay, Shikoku, 90-190 m, 2.X.1989, beam trawl by RV *Toyohata-Maru*, coll. K. Sasaki: 2 ♂♂ SL 5.4, 8.2 mm: 4 ♀♀ SL 4.3-6.4 mm (CBM-ZC 637). — Off Kii Minabe, Kii Peninsula, 80-100 m, 24.III.1995, gill net, coll. T. Komai: 1 ♂ SL 7.3 mm (CBM-ZC 1162). — Off Kochi, Tosa Bay, 150-154 m, 5.III.1993, beam trawl by RV *Toyohata-Maru*: 3 ♀♀ SL 5.6-7.5 mm (CBM-ZC 3389). — Off Kochi, Tosa Bay, 188-190 m, 10.VIII.1992, beam trawl by RV *Toyohata-Maru*, coll. K. Sasaki: 3 ♂♂ SL 7.0-8.4 mm, 1 ovig. ♀ SL 8.8 mm (CBM-ZC 3462). — Off Kochi, Tosa Bay, 110-130 m, 14.XI.1988, beam trawl by RV *Toyohata-Maru*, coll. T. Komai: 3 ♂♂ SL 7.4-12.3 mm, 2 ♀♀ SL 10.0, 13.2 mm (HUMZ-C 666). — Off Hayama, Miura Peninsula, Sagami Bay, depth unknown, 22.V.1925, beam trawl: 2 ♂♂ SL 7.4, 8.3 mm, 1 ♀ SL 8.1 mm, 1 ovig. ♀ SL 8.4 mm (SMI-NSMT-CrR 120). — Kannonzuka-dashi, Amadaiba, Sagami Bay, 60-80 m, 16.VII.1957: 1 ♂ SL 11.0 mm (SMI-NSMT-CrR 1312). — Off Jogashima, Sagami Bay, 80-85 m, 25.VII.1959: 1 ♂ SL 8.2 mm (SMI-NSMT-CrR 1617). — Off Jogashima, Sagami Bay, 110-175 m, 6.II.1954: 1 ♂ SL 8.0 mm (SMI-NSMT-CrR 2198). — Off Jogashima, Sagami Bay, 83 m, 26.I.1965: 1 ♂ SL 7.0 mm (SMI-NSMT-CrR 2303). — Kannonzuka-dashi, Amadaiba, Sagami Bay, 65-68 m, 14.III.1968: 1 ovig. ♀ SL 5.0 mm (SMI-NSMT-CrR 3568). — Off Kochi, Tosa Bay, 190 m, 6.IX.1989, beam trawl by RV *Toyohata-Maru*, coll. K. Sasaki: 1 ♀ SL 6.7 mm (USNM 284142). — Off Kochi, Tosa Bay, 33°16.14'N - 133°40.13'E, 186-190 m, 17.V.1993, beam trawl by RV *Toyohata-Maru*, coll. K. Sasaki: 1 ♂ SL 7.2 mm (USNM 284143).
Taiwan. Off Ta-Shi, NE Taiwan, I-Lan County, depth unknown, 26.I.1997, commercial trawler, coll. T.-Y. Chan: 1 ♂ SL 8.7 mm (NTOU).

DISTRIBUTION. — Known with certainty from the Pacific coast of Japan from Kashima, Ibaraki, southward to Kagohima, Goto Islands, Kosiki Islands, Taiwan (new record), at depths of 30-300 m. It remains unclear whether *P. nipponensis* occurs in the Japan Sea.

SIZE. — Largest ♂: 12.3 mm in SL, largest ♀: 13.2 mm in SL, smallest ovigerous ♀: 5.0 mm in SL.

HABITAT. — Found in gastropod shells (apparently prefers naticid shells), usually with one or more anthozoan polyps attached to the shell. Inhabiting sandy or sandy mud bottom often mixed with shell fragments, at depths of 30-300 m.

DIAGNOSIS

Shield, cephalic appendages, and chelipeds (Fig. 6A-C) similar to those of *Parapagurodes gracilipes*. Dactyls of second and third pereopods (Fig. 6D, E) slender, occasionally elongate, 1.14-1.63 times longer than propodi in second pair, 1.38-1.65 times longer in third pair, ventral margins each with 37-62 small corneous spinules, carpi with granulate ridge on each lateral surface, meri of second pereopods relatively slender. Right coxa of fifth pereopod in males with short sexual tube, sometimes curved posteriorly; left coxa with gonopore encircled posteriorly by row of setae, no sexual tube. Telson (Fig. 6F, G) with posterior margin deeply concave, each terminal margin strongly oblique, with eight or nine small spines increasing in size laterally and one strongly ventrad curved spine at posterolateral corner. Eleven pairs of phyllobranchiae.

COLORATION

In life: shield generally brown, but mottled or reticulated with brown and cream under higher magnification. Posterior carapace reddish brown. Ocular peduncles with base colour grey-brown, reticulated basally, becoming darker toward corneal base. Antennular peduncles mottled brown, with few dark brown spots on distal segment. Antennal peduncles mottled or reticulated with grey-brown, with tinge of red at articulations of each segment. Merus of third maxilliped with strong iridescence on dorsal surface. Palm of right cheliped generally brown, paler laterally and mesially, without longitudinal lines of blue iridescence on dorsal surface; palm of left cheliped without line of iridescence medially; spines, tubercles or protuberances on both palm dark brown; carpi of both chelipeds generally brown, with spines or tubercles darker; meri generally pale yellowish brown, becoming darker distally, protuberances dark brown; each segment with

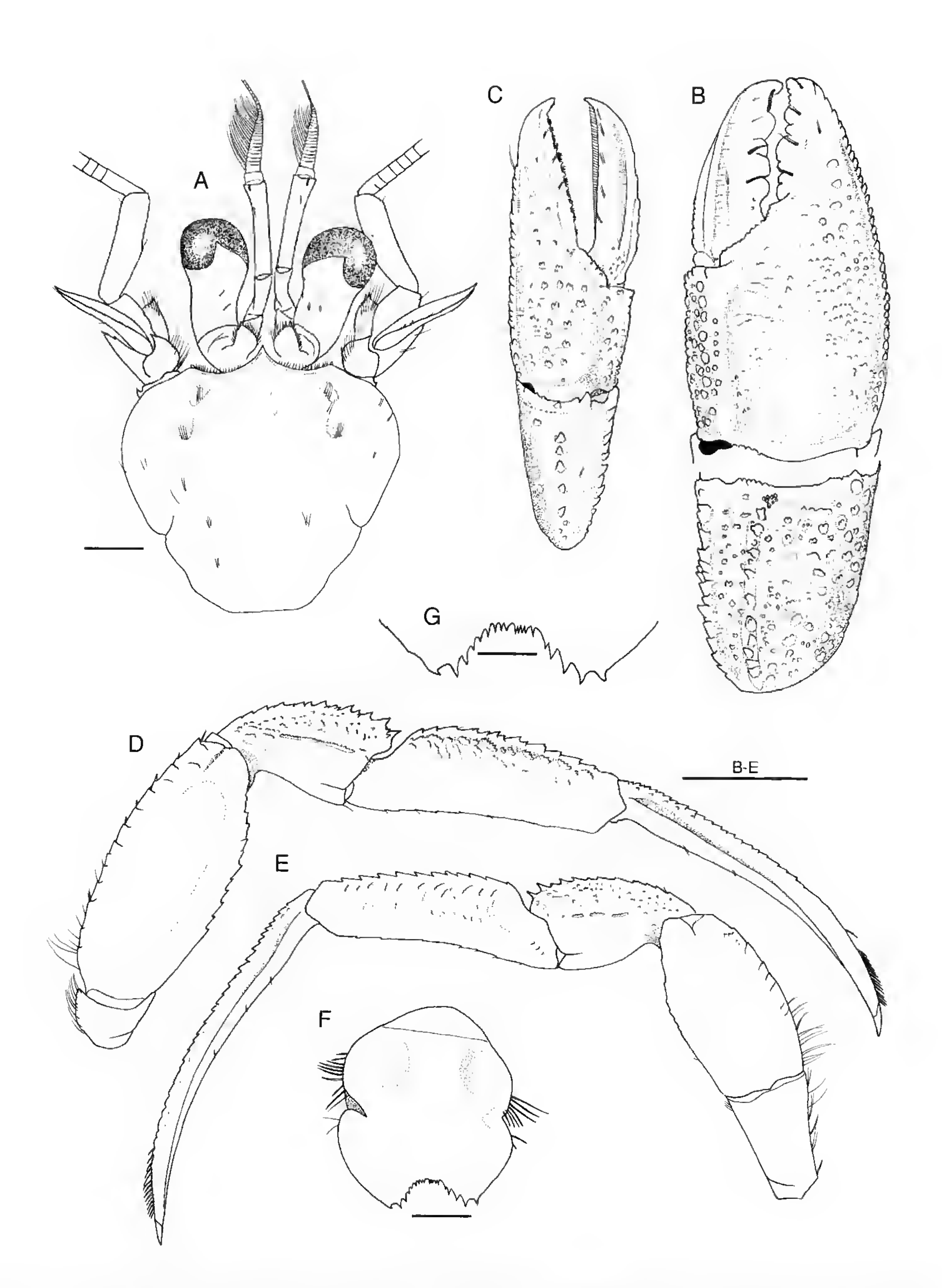


FIG. 6. — *Parapagurodes nipponensis* (Yokoya, 1933), ♂ SL 8.4 mm (CBM-ZC 3462), Tosa Bay, Shikoku, Japan; **A**, shield and cephalic appendages, dorsal; **B**, chela and carpus of right cheliped, dorsal; **C**, chela and carpus of left cheliped, dorsal; **D**, right second pereopod, lateral; **E**, left third pereopod, lateral; **F**, telson, dorsal; **G**, same, posterior margin, dorsal. Scale bars: A, 2 mm; B-E, 5 mm; F, 1 mm; G, 0.5 mm.

strong iridescence. Dactyls of ambulatory pereopods with three dark grey and two cream stripes on lateral surface, becoming obscure distally; propodi with lateral surfaces bearing three cream (dorsal, middle and ventral) and two brown stripes; carpi grey-brown generally, lateral surface ventral to granular ridge appearing as dark grey line with tinge of reddish brown, tubercles and dorsal row of spines dark brown; meri mottled or reticulated with yellowish brown, becoming darker distally and dorsally, with spots of dark brown on lateral surfaces, dorsal protuberances dark brown; carpi and meri with strong iridescence.

In preservative: faded into straw colour entirely.

Remarks

Yokoya (1933) described *Eupagurus nipponensis* on the basis of twenty-nine specimens from twelve *Soyo-Maru* stations: north of Inubo-zaki, Chiba, 33 m (stn 133); south of Misaki, Sagami Bay, 106 m (stn 238), Suruga Bay, 64 m (stn 267); Suruga Bay, 91 m (stn 277); south of Omae-zaki, Shizuoka, 79 m (stn 278); south of Lake Hamana, 77 m (stn 288); east of Sata-misaki, Kagoshima, 117 m (stn 298); south of Owase, Mie, 123 m (stn 360); near Omae-zaki, Shizuoka, 64 m (stn 376); south of Koshiki Islands, 132 m (stn 132); southeast of Goto Islands, 152 m (stn 431); and Tsugaru Strait, 91 m (stn 651). Yokoya's original description and figure of the species was presumably based on the ovigerous female from Kagoshima (stn 298). He did not designate a holotype, and therefore, all specimens are syntypes. Despite my attempts, I was able to find only a single lot containing one male (SL 8.0 mm) and one ovigerous female (fragmented!) from south of Omae-zaki, Shizuoka (stn 278), in the collection of the Kitakyushu Museum of Natural History. I selected herein this male specimen as a lectotype for *Parapagurodes nipponensis*. The lectotype is dried, and its poor condition prevents me from making detailed observations.

Discussion on *Parapagurodes gracilipes* and *P. nipponensis*

The present study discloses the presence of a short right sexual tube in males of the two taxa which have been previously assigned to *Pagurus*. The tube is quite small, usually translucent, and often curved posteriorly, making it easily overlooked in casual examination. It is interesting to note that the two species show close resemblance to the members of the *bernhardus* group of *Pagurus* proposed by McLaughlin (1974), containing *P. bernhardus* (Linnaeus, 1758), *P. armatus* (Dana, 1851), *P. ochotensis* Brandt, 1851, *P. aleuticus* (Benedict, 1892) and *P. acadianus* (Benedict, 1901). The characters showing similarity include a recurved external lobe of the endopod of maxillule; short, stout ocular peduncles with ovately dilated corneae; slightly raised dorsolateral and dorsomesial margins of the palm of chelae; and elongate, strongly twisted dactyls of the second and third pereopods, which bear prominent median sulcus on each lateral and mesial surfaces. The absence of the right sexual tube in males has been confirmed for *Pagurus armatus*, *P. ochotensis* and *P. aleuticus* (*cf.* McLaughlin, 1974; pers. obs.), but it needs to be verified for *P. bernhardus* and *P. acadianus*. Apart from the presence of a short right sexual tube, *P. gracilipes* and *P. nipponensis* do not show close resemblance to the three previously described species of *Parapagurodes* (*P. makarovi* McLaughlin *et* Haig, 1973; *P. laurentae* McLaughlin *et* Haig, 1973, and *P. hartae* McLaughlin *et* Jensen, 1996) and

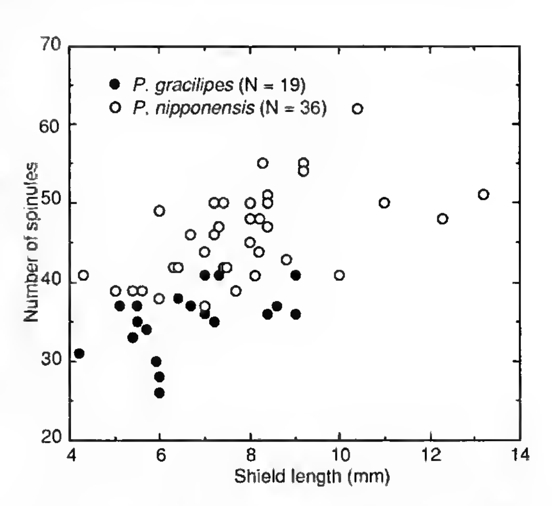


Fig. 7. — Scatter plot of number of ventral spinules on dactyl of left third pereopod and shield length for *Parapagurodes gracilipes* and *P. nipponensis*.

they are immediately distinguished from the latter three species by the characters above mentioned. The strong similarity found between two species herein assigned to *Parapagurodes* and the *bernhardus* group of *Pagurus* may cause a question about the phylogenetic significance of the sexual tube development exhibited by the genus *Parapagurodes*. The present generic assigment should be considered provisional, at least until such time as the phylogenetic significance of the sexual tube development in the Paguridae is thoroughly discussed.

Parapagurodes gracilipes and *P. nipponensis* are quite similar. At present, the geographical ranges of *P. nipponensis* appear restricted to the central and southwestern parts of the Japanese main islands, from Kashima, Ibaraki to southern Kyushu and Taiwan, whereas *P. gracilipes* is distributed from Choshi, Chiba northward to Hokkaido, Sakhalin, and the continental coast of Russia (and probably Korea). Only in the southern part of the Kashima-nada region of the Pacific coast, are these two species likely to overlap. However, the available data strongly suggest that they are bathymetrically separated in the region: *P. gracilipes* occurs at depths shallower than 42 m, and *P. nipponensis* occurs at depths greater that 30 m. The telson provides a good character to separate the two species. In *P. gracilipes*, the posterior margin of the telson is less concave, with the terminal margins nearly horizontal (Fig. 2H). In contrast, in *P. nipponensis*, the posterior margin of the telson is noticeably concave, with the terminal margins strongly oblique (Fig. 6G); the spines on the terminal margin may be more widely separated in *P. nipponensis* than in *P. gracilipes*. *Parapagurodes nipponensis* usually has more numerous spinules on the ventral margin of the ambulatory dactyls than *P. gracilipes*. For example, the dactyl of the left third pereopod bears thirty-seven to sixty-two spinules (45.9722 on average; N = 36) in *P. nipponensis*, whereas it bears twenty-six to forty-one spinules (35.0555 on average; N = 19) in *P. gracilipes* (see Fig. 7). Live colotation is different in the two species. In *P. gracilipes*, the palm of the right cheliped bears a clear longitudinal line of blue grey iridescence that is absent from the right palm of *P. nipponensis*. In *P. nipponensis*, the propodi of the second and third pereopods bear clear brown and cream stripes on the lateral surfaces, whereas in *P. gracilipes*, the segments are devoid of clear stripes on the lateral surfaces.

The type material of *P. nipponensis* included specimens from a station in Tsugaru Strait, very near Hakodate, the type locality of *P. gracilipes*, and Inubo-zaki, where the two species are likely to overlap. I could not confirm the identity of those specimens as they could not be located. Therefore, Yokoya's reference is listed questionably as "in part" in the synonymy because of the possibility that the type material might include specimens of the two species. Makarov (1938; 1962) placed Yokoya's taxon in synonymy with *P. gracilipes* without comment. The citations by Alcock (1905), Vinogradov (1950), Miyake (1965; 1975; 1982) and Takeda (1982) of *Pagurus gracilipes* are listed as "in part" because their general accounts include the ranges of both species. The reports by Doflein (1902), Balss (1913), Miyake & Imafuku (1980) and Baba (1986) of *Pagurus gracilipes* pertain exclusively to the taxon occurring in Sagami Bay, Kii Peninsula, or Tosa Bay, and therefore are referable to *Parapagurodes nipponensis*. I reexamined the specimens from Sagami Bay referred to as *Pagurus gracilipes* by Miyake (1978), and confirmed that all actually represent *Parapagurodes nipponensis*.

Genus *Pagurus* Fabricius, 1775

Pagurus alaini n.sp.
(Figs 8-11)

TYPE MATERIAL. — **Japan.** Off Kochi, Tosa Bay, Shikoku, 33°15'N - 133°39'E, 188-190 m, 10.VIII.1992, beam trawl by RV *Toyohata-Maru* of Kochi University, coll. K. Sasaki: holotype ♂ SL 7.7 mm (CBM-ZC 3416). — Same data, 190 m, 7.VII.1992, beam trawl by RV *Toyohata-Maru*, coll. K. Sasaki: 2 paratypes ♂♂ SL 4.6, 10.0 mm, CBM-ZC 3417. — Same data: 1 paratype ♂ SL 6.1 mm (MNHN-Pg 5497). — Off Saiki, Bungo Strait, 150-200 m, 7.XI.1994, commercial trawler, coll. T. Komai: 1 paratype ♂ SL 4.0 mm, 1 ovig. ♀ SL 4.3 mm (CBM-ZC 3418).

DISTRIBUTION. — Known only from Tosa Bay, Shikoku, and Bungo Strait, Japan, 188-190 m.

SIZE. — Largest specimen: SL 10 mm; ovigerous ♀: SL 4.3 mm.

HABITAT. — Found inhabiting gastropod shells.

ETYMOLOGY. — This species is dedicated to Dr Alain Crosnier, the eminent scientist of ORSTOM, Paris. I would like to express herein my sincere thanks to him for his generous help in various ways.

DESCRIPTION

Shield (Fig. 8A) as wide as or wider than long; anterolateral margins terraced; anterior margin between rostrum and lateral projections concave; posterior margin rounded; dorsal surface convex, generally smooth, with few tufts of short setae laterally. Rostrum slightly exceeding lateral projections, broadly triangular, with or without small terminal spinule, with few setae dorsally. Lateral projections triangular, well-produced, with long terminal spine. Posterior carapace (Fig. 8B) with scattered tufts of short setae dorsally; posteromedian plate calcified; cardiac sulci nearly parallel, not extending to posterior margin of carapace; sulci cardiobranchiales noticeably divergent posteriorly, extending posteriorly beyond cardiac sulci.

Ocular peduncles (Fig. 8A) 0.52-0.7 times as long as shield, stout, not inflated basally, corneal region ovate, noticeably dilated; dorsomesial surface with longitudinal row of tufts of short setae. Ocular acicles triangular, dorsal surface weakly concave, terminating subacutely, usually with prominent submarginal spine.

Antennular peduncles (Fig. 8A) exceeding ocular peduncles by 0.5-0.7 length of ultimate segment; ultimate segment about 1.5 times longer than penultimate segment, with row of setae dorsally; basal segment stout, inflated ventrally and laterally, bearing acute spine laterally.

Antennal peduncles (Fig. 8A) exceeding ocular peduncles by half to three-fourths length of fifth segment, with supernumerary segmentation. Fifth segment unarmed, with few setae on mesial surface. Third segment with ventromesial distal angle produced, terminating in prominent spine partially obscured by tufts of moderately long setae. Second segment with dorsolateral distal angle produced, terminating in simple spine, mesial margin with seven to nine small spines increasing in size distally; dorsomesial distal angle with prominent spine, mesial surface with numerous setae. First segment with or without spine laterodistally, ventrodistal margin with prominent spine at distolateral angle. Antennal acicle slightly arcuate, distinctly overreaching distal corneal margin, mesial margin unarmed, but with numerous setae. Antennal flagella long, simple.

Mandible (Fig. 9A) typical of genus. Maxillule (Fig. 9B) with proximal endite subquadrate; endopod with one bristle and one seta on well-developed, broadly based internal lobe, external lobe produced, not recurved. Maxilla (Fig. 9C) with endopod inflated basally, reaching distal margin of scaphognathite. First maxilliped (Fig. 9D) with endopod extending beyond distal margin of distal endite. Second maxilliped (Fig. 9E) with basis-ischium fusion incomplete. Third maxilliped (Fig. 9F) with basis-ischium fusion incomplete; basis (Fig. 9G) with few prominent spines mesially; crista dentata (Fig. 9G) composed of relatively stout spines, becoming smaller distally, accessory tooth strong, stout; merus usually with acute spine on dorsodistal margin; carpus with dorsodistal margin unarmed. Third thoracic sternite with distal margin slightly convex, with assemblage of setae medially.

Right cheliped of male (Figs 9H, I, 10A, B) considerably elongate, not setose. Chela 2.0-2.2 times longer than wide. Dactyl shorter than palm; dorsal surface convex with obtuse ridge mesial to midline, granular, bearing few tufts of stiff setae; dorsomesial margin not distinctly delimited; mesial surface granular, with few tufts of short setae; ventral surface almost smooth, with tufts of moderately short setae; cutting edge with row of moderately strong calcareous teeth and short row of small corneous teeth subdistally, terminating in calcareous claw. Cutting edge of fixed finger with row of moderately strong calcareous teeth in proximal 0.75 and small calcareous teeth in distal 0.25, terminating in calcareous claw. Palm slightly longer than carpus; dorsal surface convex, granular (granules subsquamate under high magnification, often forming transverse rows, Fig. 9I), dorsomesial margin nearly straight, not strongly delimited but weakly eleva-

ted, dorsolateral margin convex, with row of small blunt spines or granules, extending posteromesially, and becoming stronger distally; mesial, lateral and ventral surfaces granular; ventral surface moderately inflated, with tufts of moderately short or long setae on fixed finger.

Carpus distinctly broadened distally, with small to moderately strong spines on dorsomesial margin, dorsolateral margin not delimited, dorsal surface with moderately strong spines and multifid or simple tubercles of various size, distal margin with few spines; lateral surface with

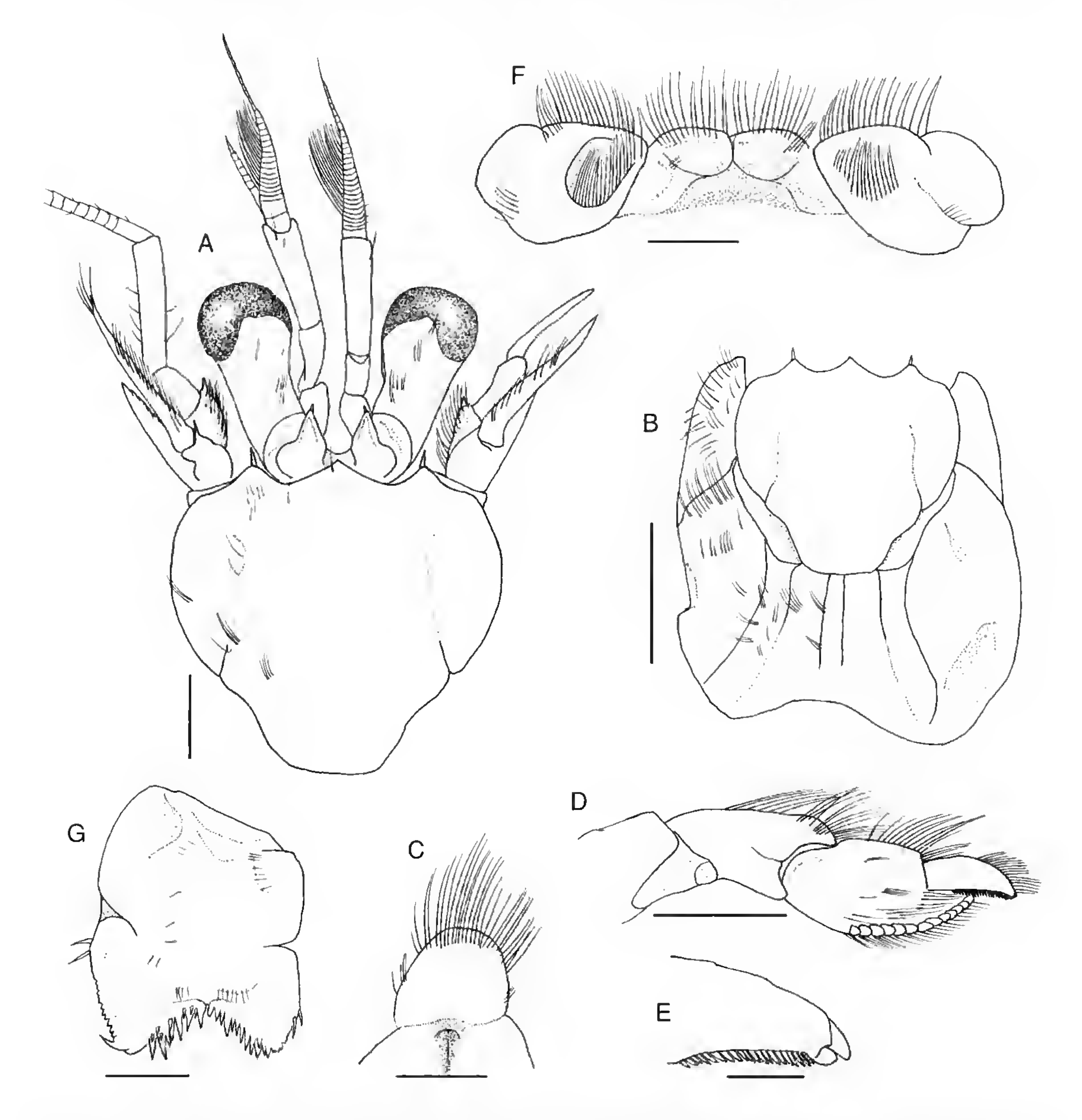


FIG. 8. — *Pagurus alaini* n.sp., holotype ♂ SL 7.7 mm (CBM-ZC 3416), Tosa Bay, Shikoku, Japan; **A**, shield and cephalic appendages, dorsal (setae on right side partially omitted); **B**, carapace, dorsal (setae on shield and right side of remaining carapace omitted); **C**, sternal lobe of sixth thoracic somite, ventral; **D**, distal three segments of right fourth pereopod, lateral; **E**, distal part of dactyl of right fourth pereopod, lateral; **F**, coxae of fifth pereopods and sternal lobe of eighth thoracic somite, ventral; **G**, telson, dorsal. Scale bars: A, D, 2 mm; B, 5 mm; C, F, G, 1 mm; E, 0.5 mm.

numerous multifid or simple tubercles; mesial surface slightly concave, with fewer small simple tubercles or protuberances, ventromesial margin with row of small tubercles; ventral surface moderately inflated, ventrolateral margin with row of small tubercles or subacute spines distally. Merus with dorsal surface bearing transverse low protuberances accompanied by bristles and tufts of moderately long setae proximally, distal margin with one prominent spine; mesial surface not granulate, lateral surface with small simple or multifid tubercles ventrally; ventral surface with moderately small tubercles (simple or sometimes multifid) or with clusters of granules, ventrolateral margin with row of small or moderately small tubercles or spines, becoming stronger and more acute distally. Ischium with scattered tufts of setae and row of small but acute spines on mesial margin.

Left cheliped (Figs 9J, 10C, D) overreaching base of dactyl of right cheliped or reaching mid-length of palm. Chela with greatest width across base of dactyl 2.4 times longer than wide. Dactyl distinctly longer than palm; dorsal surface slightly convex, mostly smooth, with median row of small simple or bifid tubercles proximally and scattered tufts of stiff setae, dorsomesial margin not distinctly delimited; mesial surface with row of small tubercles or low bifid protuberance; ventral surface almost smooth, with tufts of moderately long setae; cutting edge with row of small, acute or blunt calcareous teeth and interspersing small corneous teeth, terminating in small corneous claw. Cutting edge of fixed finger with row of small corneous teeth, terminating in calcareous claw. Palm distinctly shorter than carpus; dorsal surface with granules and small tubercles, often forming transverse rows, prominently elevated in midline and with two or three rows of small tubercles, extending onto fixed finger and increasing in size distally; dorsomesial margin not strongly delimited, dorsolateral margin nearly straight or slightly sinuous, with row of small tubercles, extending to proximal 0.3 of fixed finger; mesial surface with relatively strong tubercles dorsally, rather smooth, with few tufts of setae ventrally; lateral surface coarsely granular; ventral surface moderately inflated, nearly smooth, with scattered tufts of setae on fixed finger. Carpus slightly widened distally, with row of small tubercles and one or few moderately strong spines, dorsolateral margin with row of moderately strong spines and small spines or tubercles, dorsal surface nearly smooth, distal margin concave, with strong submedian projection, bearing few moderately strong spines; lateral surface with scattered multifid protuberances and vertical rows of granules, often bearing few setae; mesial surface with fewer moderately small, simple or multifid tubercles or protuberances, ventromesial margin with row of relatively strong simple or multifid tubercles; ventral surface moderately inflated, with low tubercles or protuberances. Merus with dorsal surface bearing transverse low protuberances, sometimes extending to mesial surface, and with bristles and tufts of moderately long setae proximally, distal margin with one prominent spine; mesial surface not granulate, but with low protuberances ventrally, lateral surface also not granulate, but with small tubercles ventrally; ventral surface with moderately small tubercles (simple or sometimes multifid) and few setae, ventrolateral margin with row of small to moderately small tubercles or spines becoming more acute distally. Ischium with scattered tufts of setae and row of small but acute spines on mesial margin.

Ambulatory pereopods (Fig. 11A-C) long, similar to left from right. Dactyls 1.45-1.81 times longer than propodi in second pair, 1.63-1.79 times longer in third pair, relatively slender; in lateral view, weakly to moderately curved ventrally; in dorsal view, weakly twisted; dorsal surfaces obtusely ridged throughout length, with small subacute protuberances and row of long bristles or small corneous spines in distal half; lateral and mesial surfaces each with prominent longitudinal sulcus, accompanied proximally with deep depression; mesial surfaces with row of small corneous spines dorsally; ventral margin weakly sinuous, with eleven to twenty-three small corneous spines, becoming longer and more closely-set distally. Propodi distinctly longer than carpi; dorsal surfaces each with irregular rows of simple or small multidenticulate spines and very few bristles, distal margins usually unarmed; lateral and mesial surfaces each with small simple or multidenticulate spines dorsally and

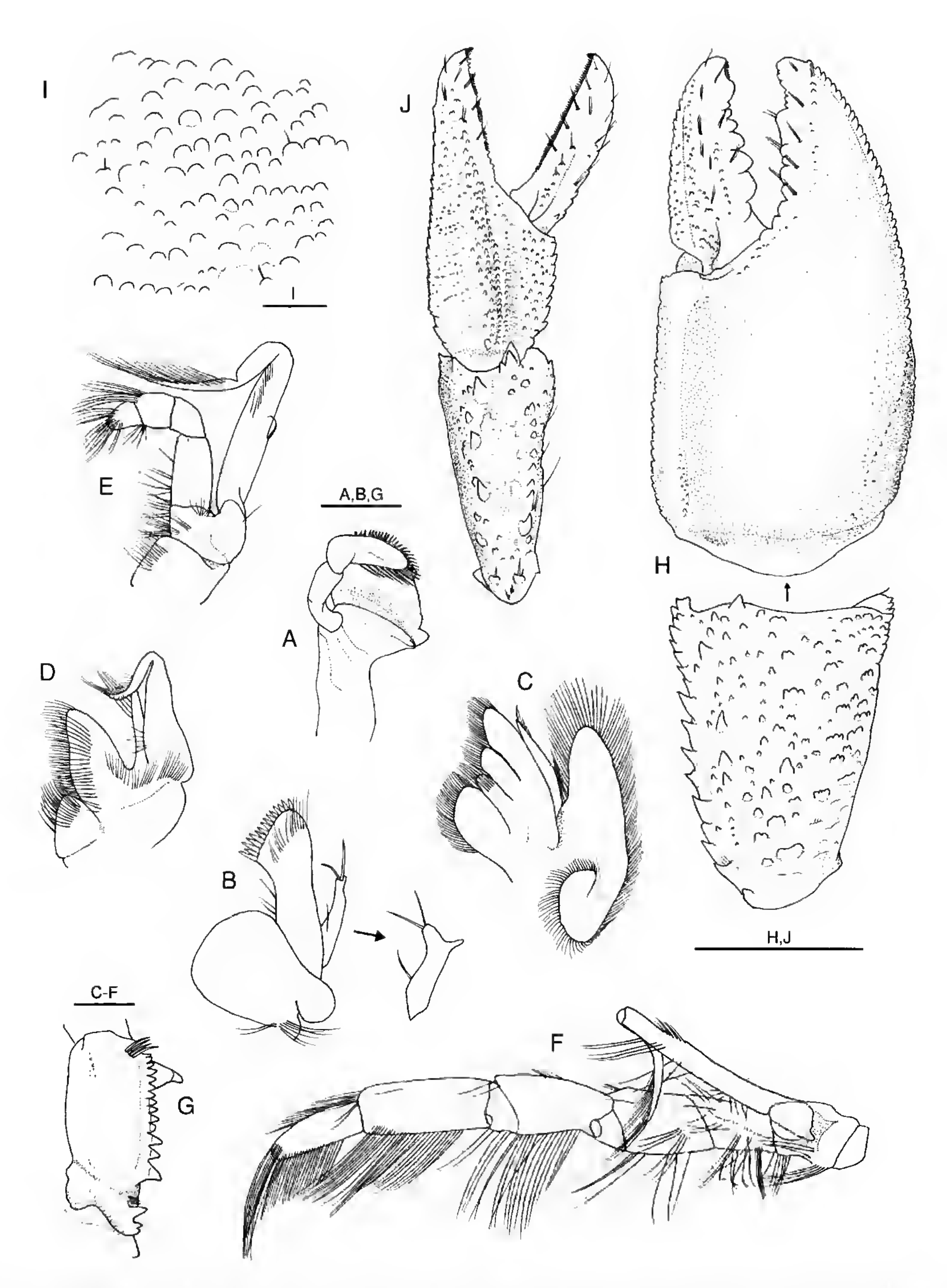


FIG. 9. — *Pagurus alaini* n.sp., holotype ♂ SL 7.7 mm (CBM-ZC 3416), Tosa Bay, Shikoku, Japan; left mouthparts; **A**, mandible, internal; **B**, maxillule, external; inset, endopod, lateral; **C**, maxilla, external; **D**, first maxilliped, external; **E**, second maxilliped, external; **F**, third maxilliped, lateral (external); **G**, ischium of third maxilliped, dorsal (internal); **H**, chela and carpus of right cheliped, dorsal (granules on dorsal surface of palm not depicted); **I**, central portion of dorsal surface of right palm, dorsal; **J**, chela and carpus of left cheliped, dorsal. Scale bars: A-G, 1 mm; H, J, 5 mm; I, 0.5 mm.

scattered minute setae ventrally, distal margins not denticulate; ventral surfaces each with row of few low protuberances and few corneous spinules, distal margins with one or two corneous spinules. Carpi much shorter than meri; dorsal surfaces each with single row of moderately small spines or spinulose tubercles, increasing in size distally; lateral surfaces each with scattered small tubercles or low protuberances, lacking longitudinal ridge; mesial surfaces nearly smooth, each

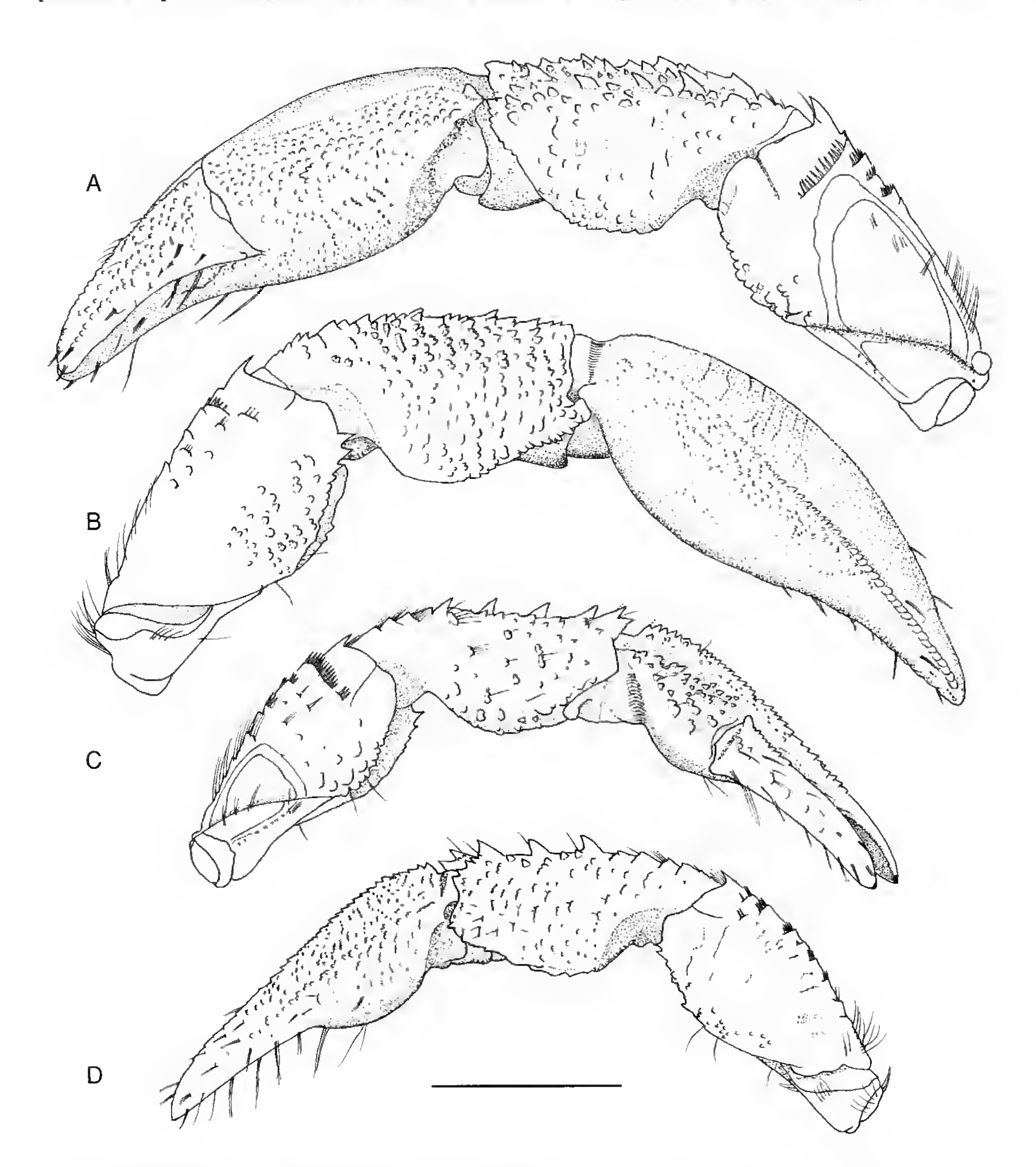


FIG. 10. — *Pagurus alaini* n.sp., holotype ♂ SL 7.7 mm (CBM-ZC 3416), Tosa Bay, Shikoku, Japan. **A**, right cheliped, mesial; **B**, same, lateral; **C**, left cheliped, mesial; **D**, same, lateral. Scale bar: A-D, 5 mm.

with few simple or bifid small tubercles dorsally; ventral surface smooth. Meri with weakly convex dorsal and ventral margins; dorsal surfaces each with transverse, multidenticulate ridges bearing bristles, mesial margins not particularly delimited; lateral surface nearly smooth, with scattered small, low protuberances dorsally and ventrally; mesial surface nearly smooth; ventral margins each with row of small protuberances. Ischia with ventral margins smooth but with few setae; dorsal surfaces each with dense setae. Coxae unarmed; female with paired gonopores on third pereopods. Anterior sternal lobe on sixth thoracic somite subovate, slightly skewed, anterior surface with long setae.

Fourth pereopods (Fig. 8D, E) setose, semichelate. Dactyl slightly curved, terminating in corneous claw, ventral margin with row of corneous spinules; preungual process distinctly smaller than terminal claw, basally articulated, showing a strongly compressed, scale-like piece. Propodal rasp composed of single row of relatively large corneous scales.

Fifth pereopods chelate. Male gonopores on coxae (Fig. 8F) each encircled by row of setae, vas deference not protruded on either side.

Sternite of eighth thoracic somite (Fig. 8F) developed anteroventrally as two subovate lobes separated by deep median and posterior grooves, anterior margins each with long setae.

Abdomen with three unequally biramous unpaired pleopods on third to fifth somites in males, exopods moderately well-developed, endopods reduced; with four unpaired pleopods in females,

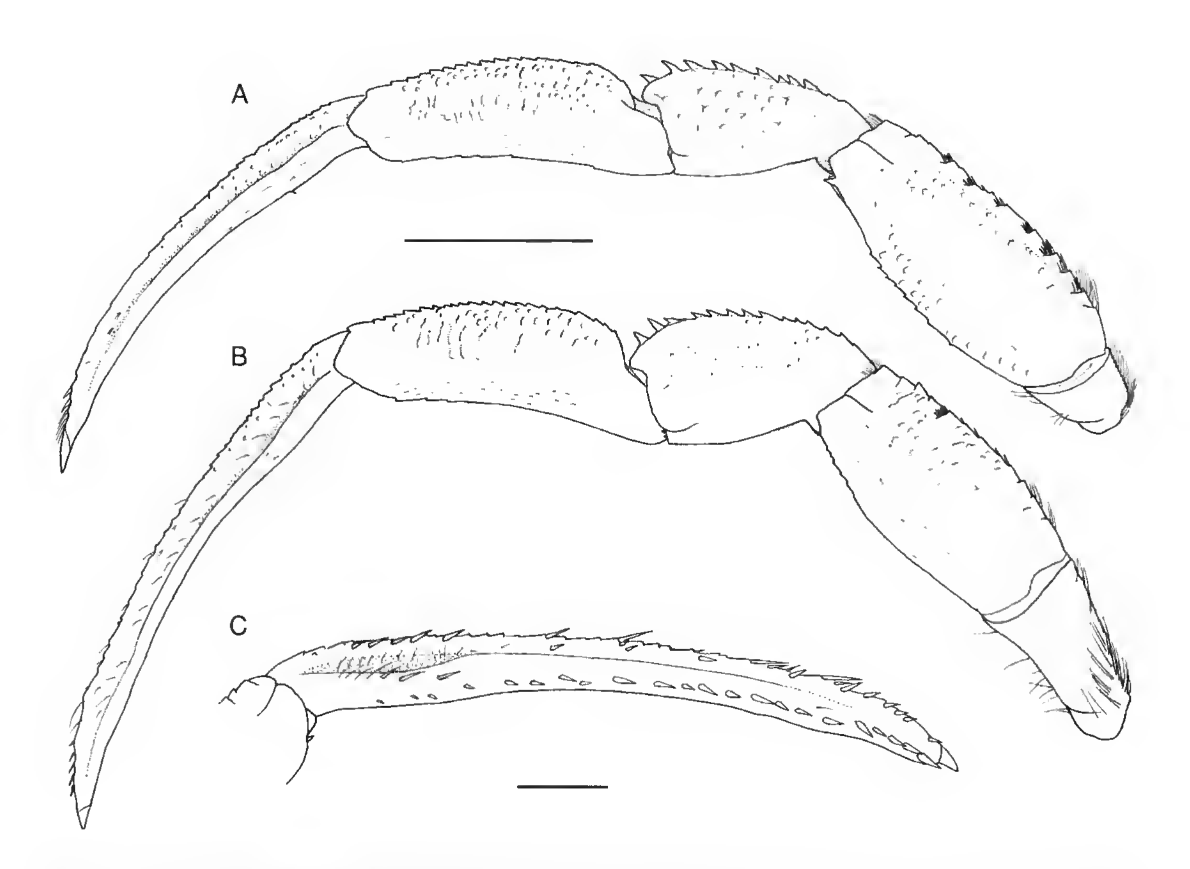


FIG. 11. — *Pagurus alaini* n.sp., holotype ♂ SL 7.7 mm (CBM-ZC 3416), Tosa Bay, Shikoku, Japan; **A**, left second pereopod, lateral; **B**, left third pereopod, lateral; **C**, same, dactyl, mesial. Scale bars: A, B, 5 mm; C, 2 mm.

second to fourth pleopods with both rami well-developed, fifth pleopod with exopod well-developed, endopod noticeably reduced.

Uropods strongly asymmetrical. Telson (Fig. 8G) with posterior lobes strongly asymmetrical, separated by indistinct or small median cleft; terminal margins oblique, with marginal and submarginal spines, strongest at outer angles; lateral margins denticulate, particularly on left side, sometimes with few corneous spinules; transverse incision moderately deep.

Eleven pairs of phyllobranchiae.

Coloration

In fresh specimens: carapace, chelipeds and ambulatory pereopods generally light brown. Chelipeds with strong iridescence on chela and carpus. Second and third pereopods with tinge of red around each articulation of dactyl, propodus and carpus, no marked stripes or bands.

In preservative: faded into straw colour generally, but iridescence on chelipeds preserved for a long time.

Remarks

The number of corneous spines on the ventral margins of the ambulatory dactyls tends to increase with growth in this new species. The right antenna and the dactyl of the right second pereopod of the holotype are apparently aberrant. The distal two segments of the antennal peduncle are abnormally short and slender and the flagellum is not fully differentiated. The dactyl of the right second pereopod is abnormally short. These are presumably due to injury.

Pagurus alaini is very similar to *P. kaiensis* McLaughlin, 1997, recently described from the Kai Islands, Indonesia. Nevertheless, it is distinguished from the Indonesian species by the relatively well-produced rostrum reaching beyond the lateral projections and the structure of the preungual process of the dactyl of the fourth pereopod. In the new species, the preungual process appears as a small scale-like piece which is distinctly smaller than the terminal claw. In *P. kaiensis*, it is a stout projection, being distinctly larger than the terminal claw. More numerous vental spines on the ambulatory dactyls (13-23 *vs* 11-14) separates *P. alaini* from *P. kaiensis*. Coloration is apparently different in the two species. In *P. alaini*, the chelipeds and ambulatory pereopods are entirely light brown or tan, sometimes with tinge of red around each articulation of the ambulatory pereopods; the dorsal surfaces of each pereopod bears strong iridescence. In *P. kaiensis*, even in preserved conditions, the chelipeds bear an overall faint orange tint, appreciably faded on the chelae, but darker on the carpi and meri; the meri have splotches of white; each ambulatory pereopod bears longitudinal stripes of orange on the lateral face of rhe carpus and the lateral, mesial, and ventral surfaces of the dactyl (McLaughlin 1997).

Although previous authors (*e.g.* Forest & de Saint Laurent 1967; McLaughlin 1974) have tried to divide the genus *Pagurus* into several informal species groups, at present no species-group assignment can be made for *P. alaini*. In the structure of the ambulatory dactyls, which are twisted and bear a prominent median sulcus on each surface, and associate proximal depressions on the lateral and mesial surfaces, as well as the armament of the posterior margin of telson, *P. alaini* (also *P. kaiensis*) appears superficially related to the members of the *bernhardus* group of *Pagurus* of McLaughlin (1974). However, the less-produced rostrum, straight, not recurved outer lobe of the endopod of maxillule, conformation of the left chela, and single row of corneous scales of the propodal rasp, exclude *P. alaini* from that group.

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Revisiting *Tylaspis anomala* Henderson, 1885 (Parapaguridae), with comments on its relationships and evolution

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ABSTRACT
The parapagurid hermit crab *Tylaspis anomala* Henderson, 1885, has been discovered living in association with anemones in New Caledonia. Very few specimens were known of this species, previously thought to carry its abdomen unprotected, or perhaps bury it in the soft bottom sediment. The study of all available specimens of this striking hermit crab revealed lack of details and morphological inaccuracies in published accounts. As a result, the monotypic genus *Tylaspis* Henderson, 1885 has been rediagnosed, and *T. anomala* Henderson, 1885 redescribed and illustrated. The genus *Tylaspis* has been found to be more closely related to another monotypic genus, *Probeebei* Boone, 1926, represented by *P. mirabilis* Boone, 1926, than to any other parapagurid genus. A summary of the taxonomy and diagnosis of *P. mirabilis* is presented. The morphological similarities and differences, pleopod development, and habitat of these two species are discussed. Possible evolutionary explanations of their unusual morphology are explored.

KEY WORDS
deep-water hermit crab, Parapaguridae, *Tylaspis*, *Probeebei*, morphology, pleopod development.

RÉSUMÉ

Réexamen de Tylaspis anomala *Henderson, 1885 (Parapaguridae) et discussion sur ses affinités et son évolution. Tylaspis anomala*, un Parapaguridae associé à des actinies, a été découvert en Nouvelle-Calédonie. On ne connaissait que très peu de spécimens de cette espèce et on croyait que son abdomen n'était pas protégé ou bien qu'elle s'enfouissait dans les sédiments meubles. L'étude de tous les spécimens disponibles de ce pagure étonnant a révélé, dans les descriptions précédentes, l'absence de détails morphologiques et des imprécisions. Le genre monotypique *Tylapsis* Henderson, 1885 est redéfini et *T. anomala* est redécrit et figuré. Le genre *Tylapsis* apparaît plus proche d'un autre genre monotypique, *Probeebei* Boone, 1926, représenté par *P. mirabilis* Boone, 1926, que d'aucun autre genre de Parapaguridae. La taxonomie et une diagnose de *P. mirabilis* sont brièvement présentées. Les similitudes et différences morphologiques, le développement des pléopodes et l'habitat de ces deux espèces sont discutés. Des hypothèses explicatives sur l'évolution de leur morphologie inhabituelle sont proposées.

MOTS CLÉS
pagures de profondeur,
Parapaguridae,
Tylaspis anomala,
Probeebei mirabilis,
morphologie,
développement des pléopodes.

INTRODUCTION

The unusual hermit crab *Tylaspis anomala* Henderson, 1885 was described from a male specimen discovered in deep waters (4344 m) of the South Pacific during the British *Challenger* expedition (1872-1876) (Henderson 1885, 1888). According to Henderson (1888), the calcified cephalothorax apparently unprotected by a gastropod shell, alone sufficed to distinguish *T. anomala* from all other hermit crabs. Since the original description, *T. anomala* has been mentioned in faunistic studies and evolutionary discussions of paguroids, or used as one of the prime examples of life in the deep sea (*e.g.* Alcock 1905; Pzibram 1905; Borradaile 1916; Wolff 1961a, b; Russell 1962; Menzies *et al.* 1973; Marshall 1979; Gage & Tyler 1991). Additional material was reported by de Saint Laurent (1972), including the first known females, based on collections obtained during one of the US *Albatross* expeditions. De Saint Laurent also reinstated and redefined the family Parapaguridae, and placed *T. anomala* in this family based on such characters as presence of labral spine, lack of exopodal flagellum on the first maxilliped, undivided abdominal tergites, unpaired left gonopore in females, and telson lacking median constriction. This familial arrangement has been followed by subsequent carcinologists (McLaughlin 1983; Lemaitre 1989, 1996).

During studies of the extensive deep-water hermit crab collections obtained during various recent French sampling campaigns in the New Caledonia region, two relatively large, well-preserved male specimens of *Tylaspis anomala* were found, each carrying an anemone as means of protection. Previous specimens of *T. anomala* had been collected without any evidence of protection for their abdomen, leading carcinologists to speculate whether this species was free-living with its abdomen unprotected (Balss 1924; Melin 1939; Wolff 1961a, b), or protected its membranous abdomen by burying it in the soft ooze of the sea floor (Borradaile 1916). The discovery of the New Caledonia specimens suggests an answer to this long-standing question. Also during this study, an additional specimen of *T. anomala* collected in the western Pacific east of Guam, was located in the Zoological Museum of Moscow State University (D. Zhadan, pers.

comm.). This finding extends considerably the distribution of this species from the eastern South Pacific to the western Pacific.

In addition to the apparent absence of shell-carrying behavior, there are also several morphological characteristics of *Tylaspis anomala* that are unusual among hermit crabs. Most striking are: the calcification of the posterior carapace and its partial fusion with the shield; the apparent absence or considerable reduction of the ocular acicles; very long, slender and spinous walking legs (second and third pereopods); the lack of propodal rasp on the fourth pereopod; and symmetrical uropods and telson. Despite the unusual features found in *T. anomala*, surprisingly few details on these and other important aspects of its morphology are available in published accounts. For example, previous descriptions of *T. anomala* indicate that males have only paired first and second pleopods, and unpaired left third to fifth (Henderson 1888; de Saint Laurent 1972). However, the New Caledonia male specimens have five pairs of pleopods, albeit the third to fifth are asymmetrical (left biramous, right uniramous and short). Detailed examination of other available material of *T. anomala*, revealed additional discrepancies or inaccuracies in published accounts of this taxon. In view of these

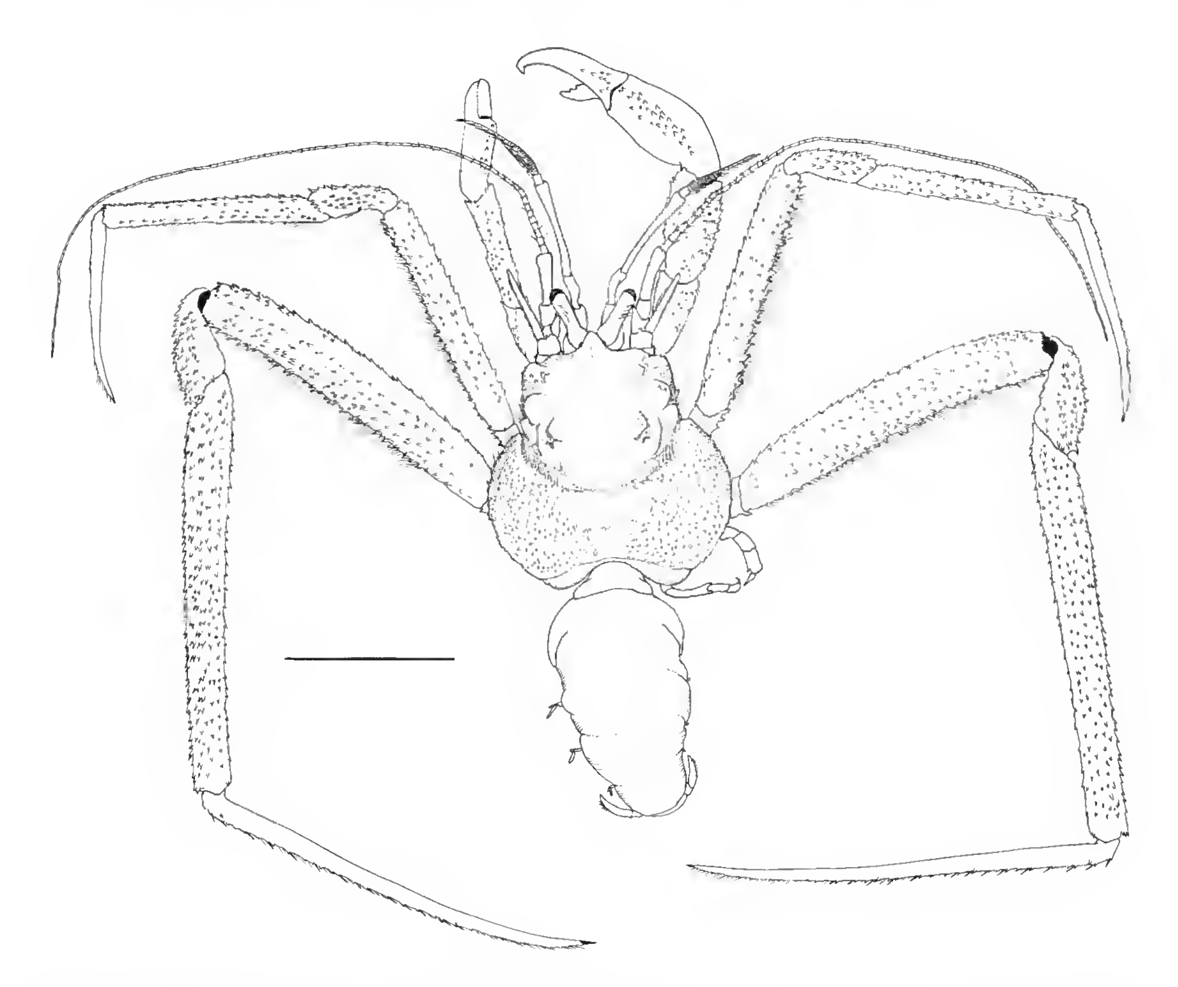


Fig. 1. — *Tylaspis anomala* Henderson, 1885, New Caledonia, BIOCAL stn CP 17, dorsal view of ♂ (SL 8.7 mm) (MNHN-Pg 5533). Scale bar: 10 mm.

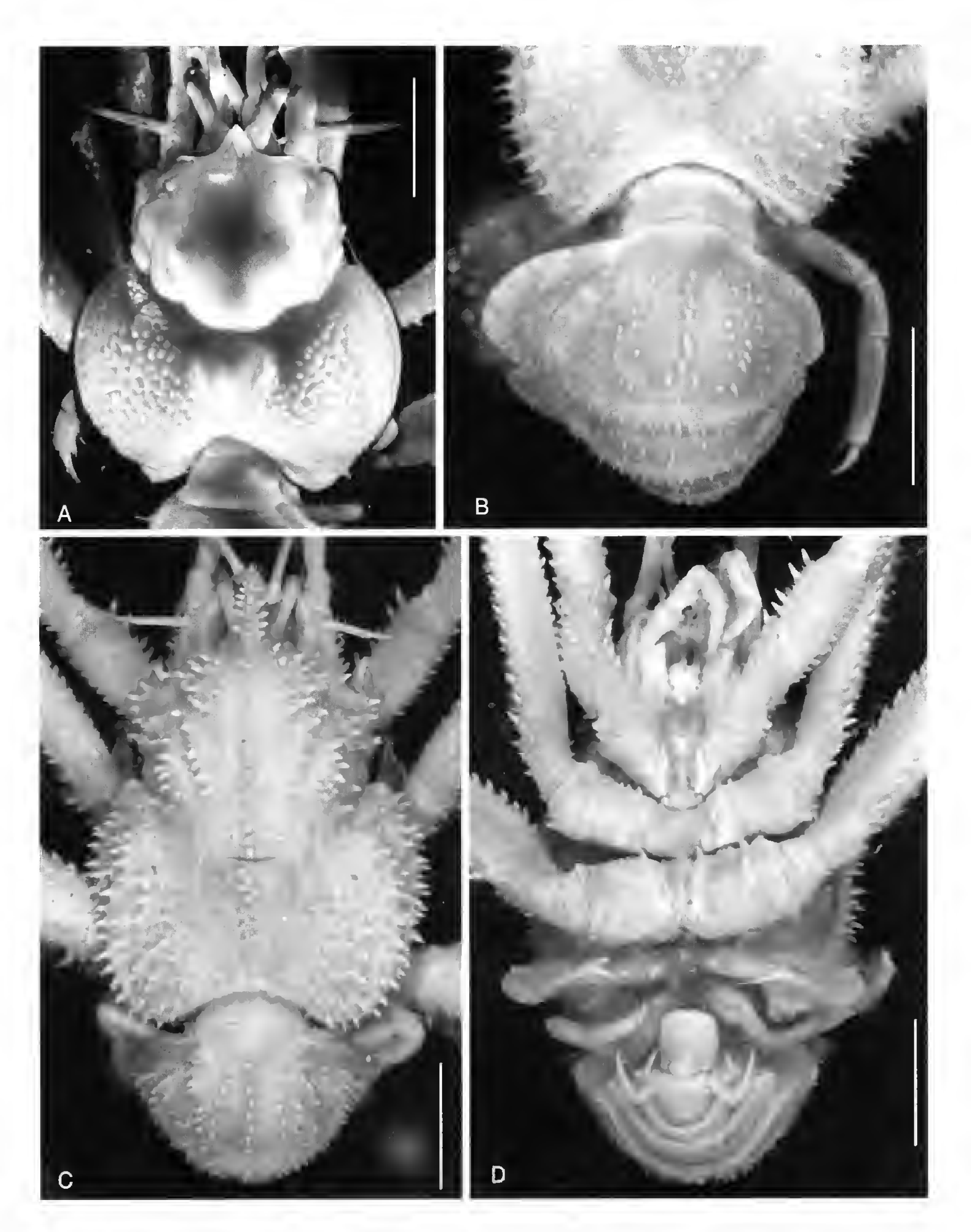


FIG. 2. — **A**, *Tylaspis anomala* Henderson, 1885, New Caledonia, BIOCAL stn CP 17, ♂ (SL 8.7 mm) (MNHN-Pg 5533): cephalic appendages, shield, and posterior carapace (dorsal view); **B-D**, *Probeebei mirabilis* Boone, 1926, eastern Pacific, off Peru, *Albatross* stn 4647, 04°33'S - 87°42'30"W, 2005 fm, 3667 m, 9.XI.1904 (USNM 267810); **B**, abdomen, posterior portion of cephalothorax and right fourth pereopod (dorsal view) of ovigerous ♀ (SL 20.7 mm); **C**, cephalothorax and abdomen (dorsal view) of ♂ (SL 23.9 mm); **D**, sternum, abdomen, uropods and telson (ventral view) of same ♂. Scale bars: A, 5 mm; B-D, 10 mm.

defficiencies, it is clear that a more detailed and accurate diagnosis of the monotypic genus *Tylaspis* is needed, as well as a redescription of its species *T. anomala.*

While comparing the morphology of *T. anomala* with that of other parapagurids, it was found that many characters are shared with another unique parapagurid, *Probeebei mirabilis* Boone, 1926, to which *T. anomala* is probably most closely related. The morphological similarities and differences of these two species are described in detail, including pleopod development as estimated from a small series of young individuals. The possible evolutionary interpretation of the unusual morphology of the cephalothorax and abdomen of these two species is briefly discussed. Although *P. mirabilis* has been previously described in detail by Wolff (1961b), it is appropriate for comparison purposes to include here a summary of its taxonomy as well as diagnostic characters based on the examination of many specimens in the collections of the National Museum of Natural History, Smithsonian Institution, Washington D. C. (USNM), and Zoologisk Museum, Copenhagen (ZMK).

The New Caledonia material of *T. anomala* is deposited in the Muséum national d'Histoire naturelle, Paris (MNHN); the type is housed in The Natural History Museum, London [formerly British Museum (Natural History)] (NHM); the *Albatross* specimens are part of the collections in the USNM; and an additional specimen is deposited in the Zoological Museum Moscow State University (ZMUM). The type of *Probeebei mirabilis* Boone, 1926 remains deposited in the American Museum of Natural History, New York (AMNH). A single measurement, shield length, indicative of size, is included in parenthesis, as measured (to the nearest 0.1 mm) from the tip of the rostrum to the midpoint of the posterior margin of the shield. General terminology follows McLaughlin (1974) and Lemaitre (1989), except for grooves, lineae, and sulci, used as summarized in Lemaitre (1995: 2, fig. 1); the sulcus verticalis was not included by Lemaitre, and is used as defined by Boas (1926) and Pilgrim (1973). The term "semichelate" is used according to the definition provided by McLaughlin (1997: 435).

SYSTEMATICS

Genus *Tylaspis* Henderson, 1885

Tylaspis Henderson, 1885: 900; 1888: 81. – A. Milne Edwards & Bouvier 1893: 7. – Alcock 1905: 25. – Borradaile 1916: 121, figs 12, 13b. – Balss 1927: 1012. – Melin 1939: 13. – Wolff 1961a: 931; 1961b: 25, fig. 11b. – Gordan 1956: 342. – de Saint Laurent 1972: 120. – Marshall 1979: 304. – Gage & Tyler 1991: 83.

TYPE SPECIES. — *Tylaspis anomala* Henderson, 1885, by monotypy.

DISTRIBUTION. — Pacific Ocean.

DIAGNOSIS

Eleven pairs of phyllobranchiate gills. Shield and

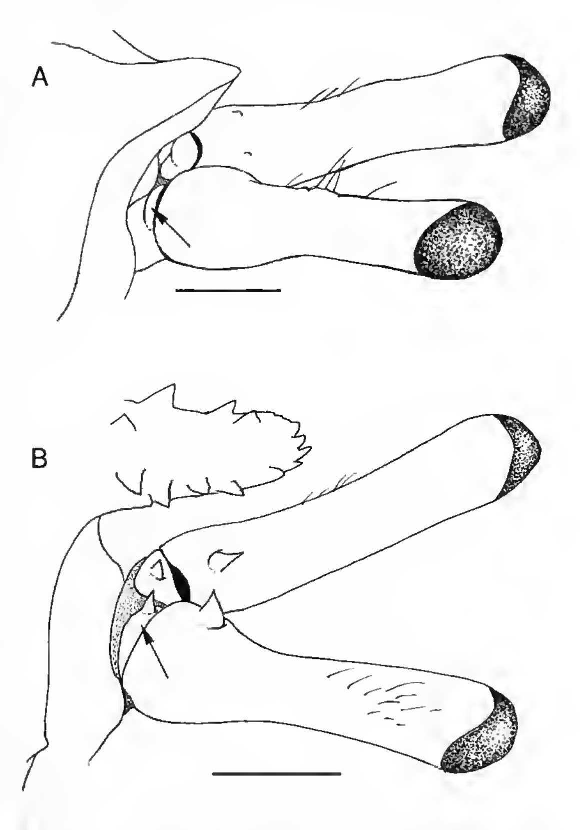


FIG. 3. — Ocular peduncles, acicles (arrows) and rostrum (dorsolateral view); **A**, *Tylaspis anomala* Henderson, 1885, New Caledonia, BIOCAL stn CP 17, ♂ (8.7 mm) (MNHN-Pg 5533); **B**, *Probeebei mirabilis* Boone, 1926, eastern Pacific, off Peru, *Albatross* stn 4647, 04°33'S - 87°42'30'W, 2005 fm, 3667 m, 9.XI.1904 (USNM 267810). Scale bars: A, 1 mm; B, 2 mm.

posterior carapace partially fused (Figs 1, 2A), well-calcified. Rostrum well developed. Branchiostegites membranous. Shield marked by deep calcified cervical groove and linea transversalis; dorsal surface strongly convex. Posterior carapace (Fig. 2A) lacking lineae or sulci; lateral margins arciform. Ocular acicles (Fig. 3A) reduced. Antennular and antennal peduncles distinctly overreaching eyestalks. Fourth segment of antennal peduncle (Fig. 4B) unarmed. Thoracic sternite (Fig. 4G) of chelipeds narrow. Sternites of second and third pereopods moderately broadened. Sternites of fourth and fifth pereopods each consisting of transverse rod subdivided in midline, that of fifth very narrow and widely separated from preceding sternite. Ambulatory legs (Fig. 1) very long and slender; second walking leg (third pereopod) distinctly longer than first (second pereopod). Abdomen membranous (Fig. 1), except for moderately calcified tergite of first somite and pleura of second somite. Uropods and telson (Fig. 4H) symmetrical. Males with well-developed paired first and second pleopods modified as gonopods, and asymmetrically paired third to fifth pleopods; left third to fifth pleopods biramous, right third to fifth rudimentary (each consisting of small bud). Females lacking first pleopods; second to fifth pleopods paired (symmetrical or asymmetrical).

Tylaspis anomala Henderson, 1885
(Figs 1, 2A, 3A, 4-7)

Tylaspis anomala Henderson, 1885 : 900, fig. 329; 1888: 81, pl. 8, fig. 5. – Alcock 1905: 191. – Pzibram 1905: 198. – Balss 1924: 763, fig. 19. – Melin 1939: 15. – Gordan 1956: 342. – Wolff 1961b: 26. – Russell 1962: 20. – de Saint Laurent 1972: 121. – Menzies *et al.* 1973: 235.

HOLOTYPE. — **South Pacific.** *Challenger*, stn 285, 32°36'S - 137°43'W, 2375 fm (4344 m): 1 ♂, 5.7 mm (NHM 1888: 33).

ADDITIONAL MATERIAL. — **New Caledonia.** NO *Jean Charcot*, BIOCAL stn CP 17, 20°35'S - 167°25'E, 3680 m, 14.VIII.1985: 2 ♂♂, 7.2, 8.7 mm (MNHN-Pg 5533).
Pacific Ocean (other). NE of Easter Island, *Albatross*, stn 4701, 19°11'S - 102°24'W, 2265 fm (4143 m), 26.XII.1904: 2 ♂♂, 6.5, 6.5 mm; 2 ♀♀, 5.9, 8.0 mm (USNM 168482). — E of Guam, *Akademik Mstislav Keldysh*, 9th cruise, stn 1065, 14°09.5'N - 155°54.04'E, 3800-4270 m, 4-5.XI.1984: 1 ♂, 8.0 mm [not seen] (ZMUM Ma-4831).

DISTRIBUTION. — Pacific Ocean: NE of Easter Island; New Caledonia; and East of Guam (D. Zhadan, pers. comm.). Depth : 3680 to 4344 m.

HABITAT AND SYMBIOTIC ASSOCIATIONS. — The specimens from New Caledonia (MNHN-Pg 5533) were each found carrying an unidentified anemone (removed and under study by D. Doumenc, A. Crosnier, pers. comm.).

REDESCRIPTION

Shield (Figs 1, 2A) approximately as broad as long. Dorsal surface strongly convex, uneven, with scattered short setae; with distinct bulges on lateral region, most bulges with one or more small spines dorsally. Rostrum prominently triangular, well in advance of lateral projections of shield; with distinct mid-dorsal ridge. Anterior margins weakly concave. Lateral projections broadly rounded. Anterolateral region with one to four small spines dorsally. Ventrolateral margin with small spine. Posterior margin broadly rounded. Anterodistal margin of branchiostegite rounded, unarmed, setose.

Posterior carapace (Figs 1, 2A) with numerous small spines on dorsolateral surfaces; dorsomedian or cardiac region somewhat elevated, glabrous, weakly subdivided into three low rounded longitudinal ridges. Branchiostegites (Fig. 4A) divided into anterior and posterior portion by broad, shallow sulcus verticalis.

Ocular peduncles less than half length of shield, inflated basally, and with short dorsal row of long setae. Cornea pigmented, width subequal to distal width of ocular peduncle.

Antennular peduncle long, slender, exceeding distal margin of cornea by half length of penultimate segment; ventral flagellum with six or seven articles. Ultimate segment twice as long as penultimate segment, with scattered setae. Basal segment with strong ventromesial spine; lateral face with distal subrectangular lobe of statocyst armed with two or three small spines, and strong simple or bifid spine proximally.

Antennal peduncle (Fig. 4B) exceeding distal margin of cornea by approximately 0.3 length of fifth segment. Flagellum long, exceeding extended

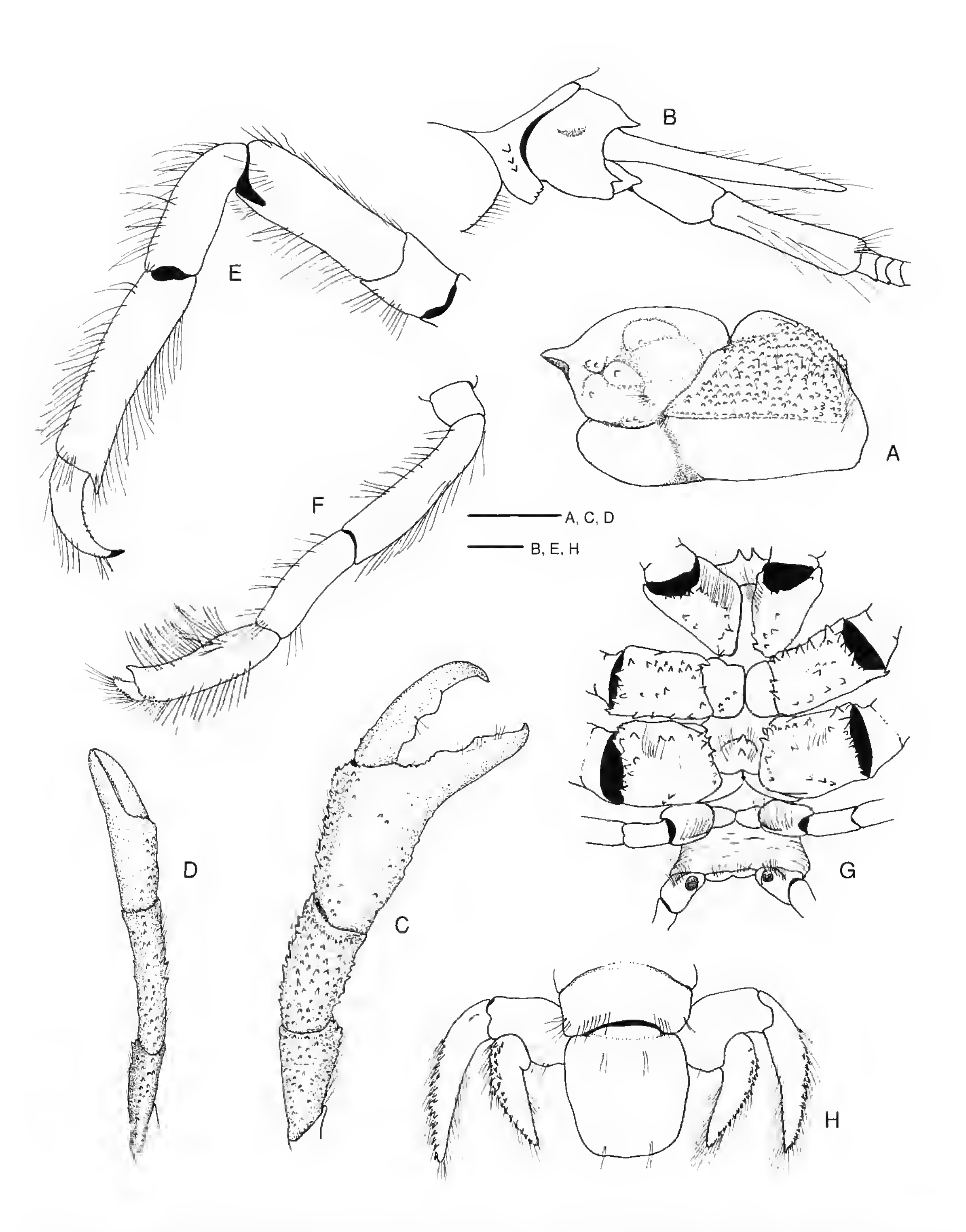


FIG. 4. — *Tylaspis anomala* Henderson, 1885, New Caledonia, BIOCAL stn CP 17, ♂, 8.7 mm (MNHN-Pg 5533); **A**, shield, posterior carapace, and branchiostegite (lateral view); **B**, right antennal peduncle (lateral view); **C**, right cheliped (dorsal view); **D**, left cheliped (dorsal view); **E**, left fourth pereopod (lateral view); **F**, left fifth pereopod (lateral view); **G**, sternite of third maxilliped, and coxae and sternite of first to fifth pereopods (ventral view); **H**, telson and uropods (dorsal view). Scale bars: A, C, D, 5 mm; B, E-H, 1 mm.

first ambulatory leg; articles with scattered setae one to two articles in length. Fifth segment unarmed, with long setae laterally and mesially. Fourth segment unarmed; with transverse dorsodistal row of setae. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle weakly produced, terminating in spine; lateral margin with one or two small spines proximally; mesial margin with spine on dorsodistal angle. First segment with two or three small spines on lateral face; ventromesial angle produced, with three or four small spines laterally. Antennal acicles straight, exceeding distal margins of corneae by 0.3 to 0.5 length of acicle, terminating in strong spine; mesial margin unarmed, setose.

Mandible (Fig. 5A) with 3-segmented palp. Maxillule (Fig. 5B, C) with external lobe of endopod weakly developed, internal lobe with two long setae. Maxilla (Fig. 5D) with endopod exceeding distal margin of scaphognathite. First maxilliped (Fig. 5E) with endopod exceeding exopod in distal extension. Second maxilliped (Fig. 5F) without distinguishing characters. Third maxilliped (Fig. 5G) with crista dentata of fourteen corneous-tipped teeth; coxa and basis each with small mesial tooth. Sternite of third maxillipeds with spine on each side of midline. Epistome unarmed.

Chelipeds dissimilar. Right cheliped (Fig. 4C) slender, with scattered short setae. Fingers subequal to length of palm, terminating in small corneous claws; tips strongly curved inwardly, crossed when closed; dorsal and ventral faces unarmed; cutting edges with irregularly sized calcareous teeth, and row of small, fused corneous teeth distally. Palm longer than broad, lateral and mesial faces rounded; dorsal and ventral faces smooth, unarmed or at most with scattered minute spines; mesial face with two or three irregular rows of small spines. Carpus with numerous small spines on dorsal and ventral surfaces, and subdistal row of small spines on dorsal face. Merus with numerous small spines on dorsal and lateral faces, mesial face smooth; ventromesial margin with row of spines. Ischium with spines on dorsal margin and ventral face. Coxa with small spines on ventral face.

Left cheliped (Fig. 4D) well-calcified, slender, with scattered setae. Fingers terminating in small corneous claws; dorsal and ventral surfaces unarmed; cutting edge of dactyl with row of minute, fused corneous teeth; cutting edge of fixed finger with row of small, regularly spaced teeth interspersed with minute corneous spines. Dactyl subequal to palm in length. Palm with dorsal and ventral surfaces unarmed, except for irregular rows of small spines on dorsomesial face. Carpus with numerous small spines on dorsal surface; ventral face with scattered small spines. Merus with small spines on dorsal and lateral faces, mesial face smooth; with ventromesial and ventrolateral row of spines. Ischium with dorsal spine and several small spines on ventral face. Coxa with small spines on ventral face.

Ambulatory legs (Fig. 1) similar from right to left, very long and slender; second walking leg exceeding first by full length of dactyl, and exceeding extended right cheliped by nearly full length of propodus. Dactyls nearly straight, approximately as long as propodi, with dorsal row of small spines and bristle-like setae, and distal dorsolateral and dorsomesial rows of long setae; ventral margin unarmed. Meri, carpi and propodi each with numerous spines (often in pairs) arranged in irregular rows on all surfaces. Ischia and coxae unarmed. Anterior lobe of sternite of third pereopods (Fig. 4G) sloping, setose, unarmed or with one or two small spines.

Fourth pereopod (Fig. 4E) semichelate. Dactyl subtriangular, strongly curved, terminating in sharp corneous claw, and with three to five minute corneous spinules on ventral margin. Propodus elongate, approximately 3.5 times as long as broad, with strong ventrodistal spine. Merus, carpus, and propodus unarmed but with long setae.

Fifth pereopod (Fig. 4F) chelate, with long setae on merus, carpus, propodus and dactyl. Dactyl and propodus each with weak rasp formed of few minute corneous spines.

Telson (Fig. 4H) lacking transverse suture, subrectangular, slightly longer than broad; posterior margin entire, broadly rounded, unarmed. Uropods (Fig. 4H) elongate, about four times as long as broad; rasps weakly developed, consisting of two or three rows of small corneous spines.

Male paired first gonopods (Fig. 6A) each with

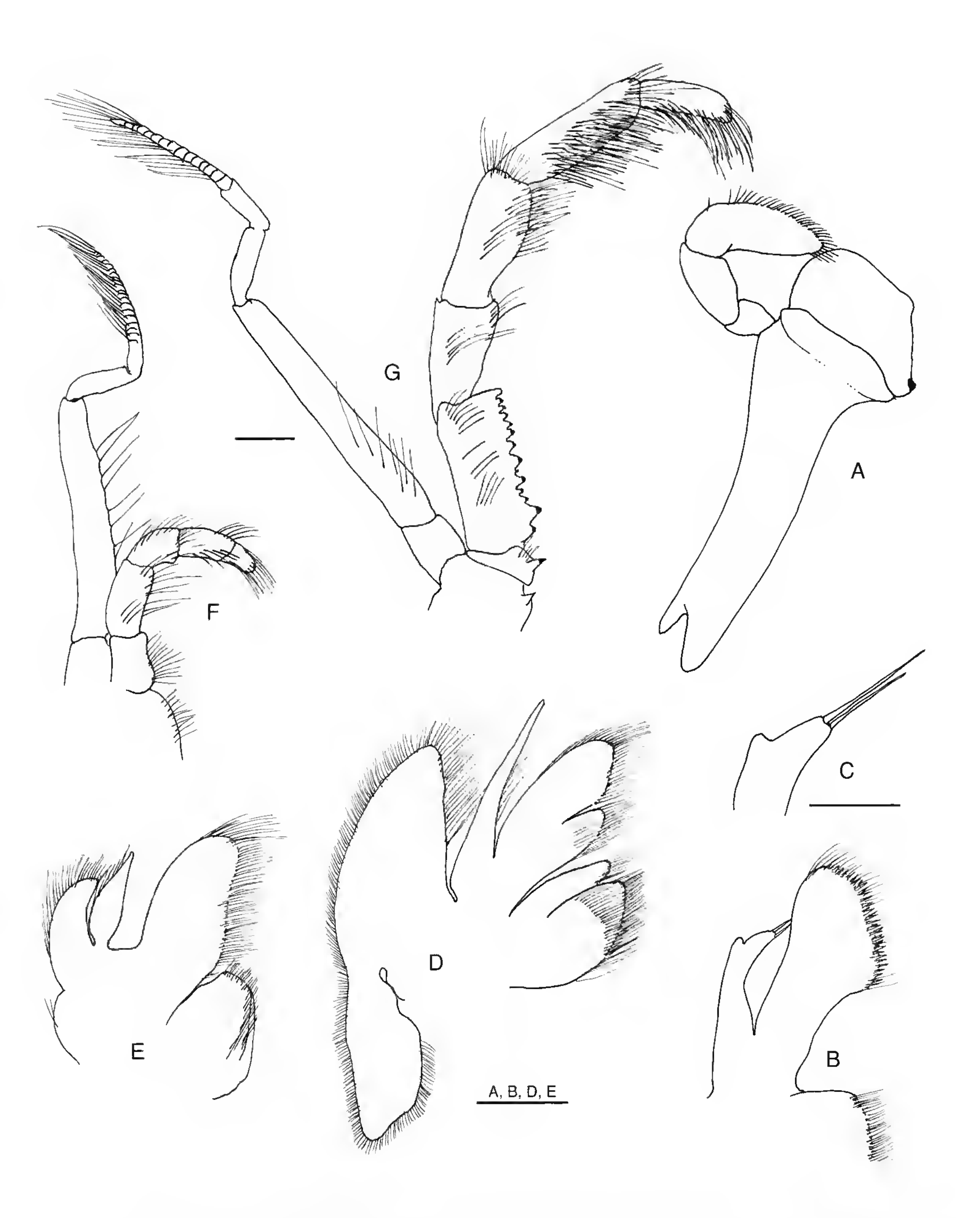


FIG. 5. — *Tylaspis anomala* Henderson, 1885, New Caledonia, BIOCAL stn CP 17, ♂, 8.7 mm, (MNHN-Pg 5533). Left mouthparts (internal view); **A**, mandible; **B**, maxillule; **C**, endopod of same; **D**, maxilla; **E**, first maxilliped; **F**, second maxilliped; **G**, third maxilliped. Scale bars: A, B, D-G, 1 mm; C, 0.5 mm.

elongate, subconical distal lobe; second paired gonopods (Fig. 6B) each with distal segment twisted distally, distomesial face setose, and with short bristle-like setae on lateral margin, with short exopod (holotype only). Smaller known female (SL 5.9 mm) with second to fifth pair of pleopods (Fig. 7A-D) symmetrical, biramous, each with short endopod and sparse setae. Largest known female (SL 8.0 mm) with second to fifth pair of pleopods asymmetrical (Fig. 7E-H); left biramous, with subequal rami; right rudimentary, each consisting of small bud.

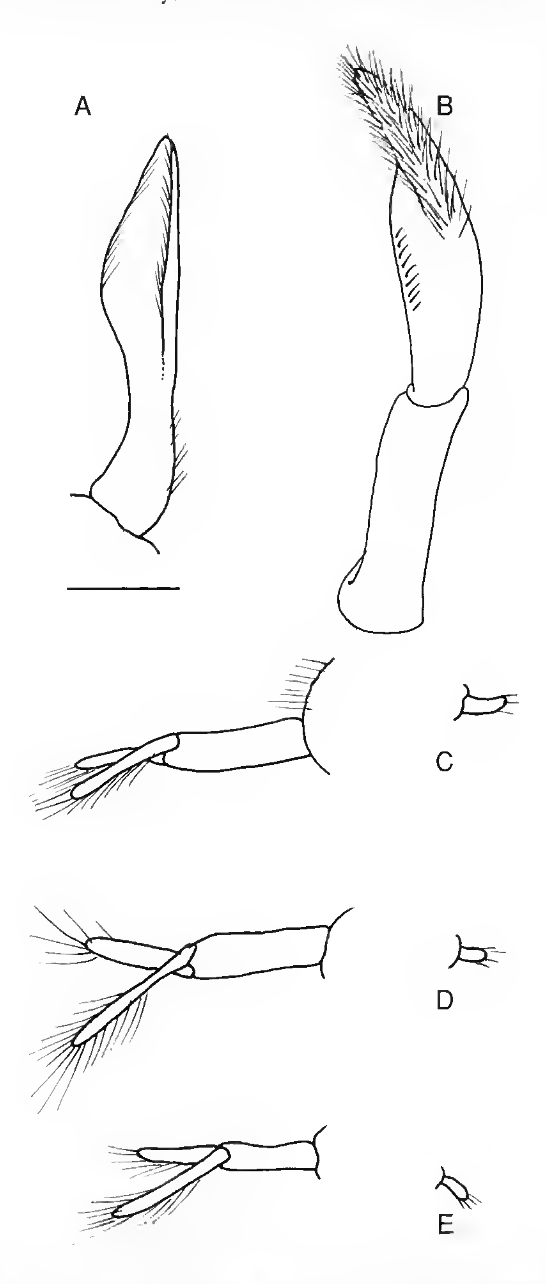


Fig. 6. — *Tylaspis anomala* Henderson, 1885, New Caledonia, BIOCAL stn CP 17, ♂, 8.7 mm (MNHN-Pg 5533); **A**, **B**, left first (mesial view) and second (anterior view) gonopods ; **C**-**E**, third to fifth pair of pleopods (left on left, right on right, lateral view); **A**, first gonopod; **B**, second gonopod; **C**, third pair; **D**, fourth pair; **E**, fifth pair. Scale bar: 1 mm.

Remarks

De Saint Laurent (1972: 121) mistakenly indicated that she examined specimens of *Tylaspis anomala* from US *Albatross* plankton station 4605. No specimens of this species were obtained at this station.

Several important morphological features of *T. anomala* have been inaccurately or insufficiently reported in previous descriptions of this species. For example, Henderson (1888) and de Saint Laurent (1972) stated that ocular acicles were absent, and this interpretation has been followed by most carcinologists. McLaughlin (1983) did suggest that the acicles in three monotypic parapagurid genera (i.e. *Tylaspis, Probeebei* and *Typhlopagurus* de Saint Laurent, 1972) were reduced or lost, but did not specify exactly which was the condition in *Tylaspis*. Although the ocular acicles in *T. anomala* are considerably reduced and indeed not easily discernible, they are present (Fig. 3A). A careful examination of *T. anomala* specimens, and their comparison with those of species from all other parapagurid genera, clearly indicates a continuum from well-developed ocular acicles (*Sympagurus* Smith, 1883, *Oncopagurus* Lemaitre, 1996, *Paragiopagurus* Lemaitre, 1986, *Strobopagurus* Lemaitre, 1989), through stages where they are reduced [*Probeebei mirabilis* Boone, 1926 (Fig. 3B), *Typhlopagurus foresti* de Saint Laurent, 1972] or moderately developed [*Bivalvopagurus sinensis* (de Saint Laurent, 1972), species of *Parapagurus* Smith, 1879], to a condition such as in *T. anomala*, where the acicles are barely discernible.

Although the partial fusion and calcification of the cephalothorax in *T. anomala* is a feature that has been previously documented, the absence of linea or sulci on the posterior carapace has not.

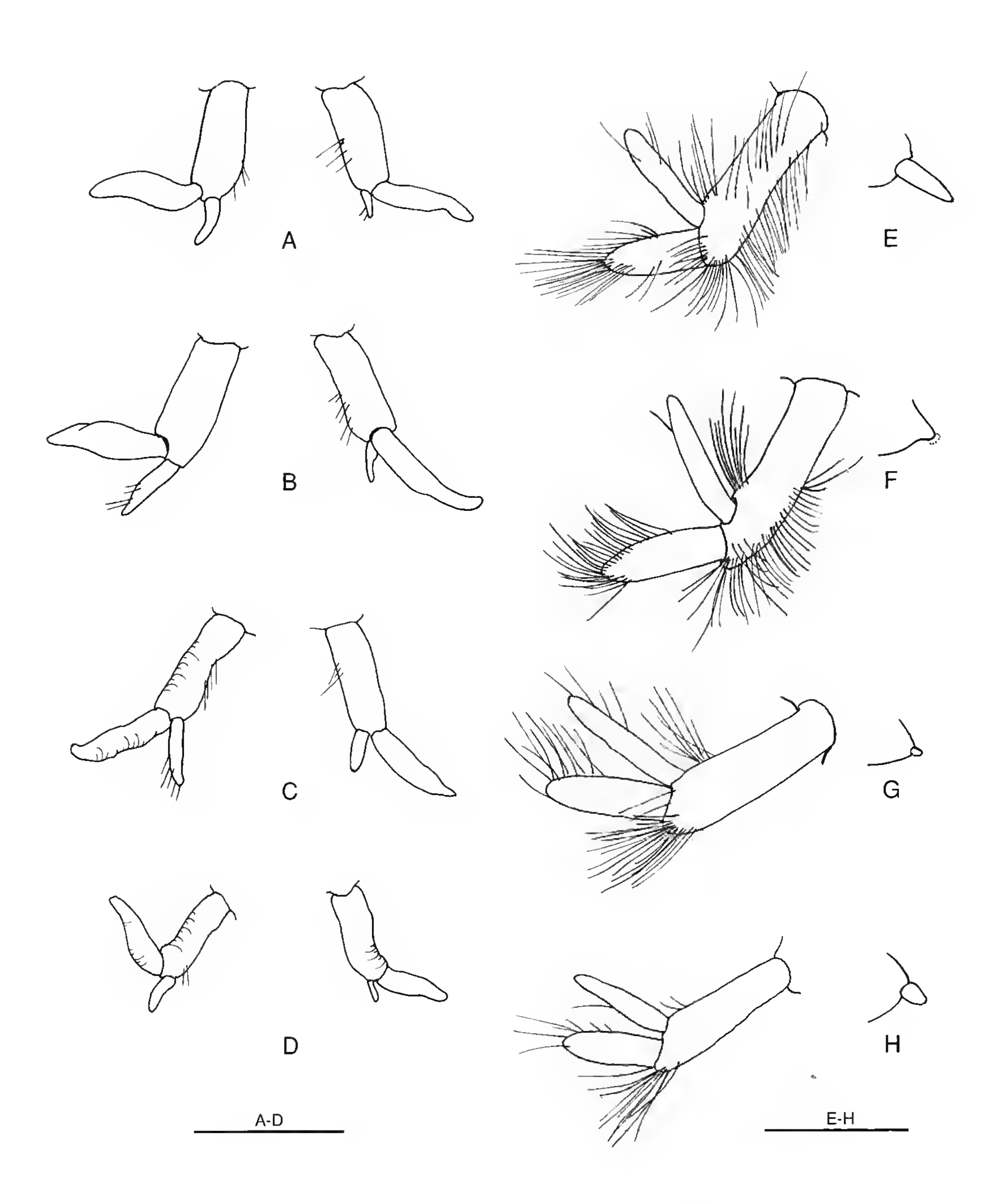


FIG. 7. — *Tylaspis anomala* Henderson, 1885, NE of Easter Island, *Albatross* Stn 4701 (USNM 168482); ♀ pleopods (left on left, right on right, lateral view), **A**-**D**, ♀, 5.9 mm: **A**, second; **B**, third; **C**, fourth; **D**, fifth; **E**-**H**, ♀, 8.0 mm: **E**, second ; **F**, third (scar only on right); **G**, fourth; **H**, fifth. Scales bars: A-D, 1 mm; E-H, 2 mm.

The partial fusion of the shield and posterior carapace is marked by a calcified deep cervical groove and lineae transversalis. On the posterior carapace, there is no evidence of lineae or sulci as seen in typical paguroids, although the slightly raised condition of the dorsomedian or cardiac region (as shown in Fig. 2A) might give the appearance that there is at least a sulcus cardiobranchialis on either side of the cardiac region.

The abdomen of *T. anomala* has been described as short, membranous, and without the usual twisting seen in typical shell-inhabiting hermit crabs (Henderson 1888), or simply membranous except for a weak calcification of the second tergite (de Saint Laurent 1972). However, the abdomen is weakly twisted to the right, at least in preserved state (Fig. 1). Examination of all available specimens has shown that in addition to the calcification seen in the pleura of the second somite, the tergite of the first somite is also similarly calcified. As previously mentioned, in the past it has been inaccurately reported that *T. anomala* males have only paired first and second pleopods, and unpaired left third to fifth. Similarly, females have been reported to have unpaired left second to fifth pleopods, with a vestigial right second pleopod (Henderson 1888 ; de Saint Laurent 1972). In actuality, the holotype as well as both of the New Caledonia male specimens have five pairs of pleopods, albeit the third to fifth pairs are asymmetrical (left biramous, right uniramous and bud-like; Fig. 6C-E). A study of the only two female specimens known (USNM 168482) shows that indeed they lack first pleopods; however, they do have paired second to fifth pleopods. In the smaller female (SL 5.9 mm), the pleopods (Fig. 7A-D) are paired, symmetrical, biramous; in the larger female (SL 8.0 mm), the pleopods (Fig. 7E-H) are also paired, but asymmetrical, with the left biramous and right considerably reduced to minute buds (only a scar is visible on the place of normal development of the right second). In both females, the unpaired left gonopore is clearly developed, suggesting maturity.

The presence of uropodal rasps in *T. anomala* has not been previously reported. Although Henderson (1888, pl. 8, fig. 5a, b) included illustrations of the uropods, he did not depict the small spines that form the rasps of these appendages (Fig. 4H).

TAXONOMY AND CHARACTERISTICS OF *Probeebei mirabilis* Boone, 1926

The monotypic genus *Probeebei*, and its species *P. mirabilis*, were originally briefly described by Boone (1926a, b) as a primitive macruran, based on a juvenile specimen obtained south of Cocos Island during the *Arcturus* Oceanographic Expedition in 1925 to the eastern Pacific. Unaware of Boone's description, Wolff (1960b) described what he thought to be a new genus and species of pagurid as *Planopagurus galathea*, based on juvenile and adult specimens obtained during the Danish *Galathea* Expedition in 1952 to the eastern Pacific. However, Fenner A. Chace, Jr. (*in litt.*) informed Wolff of Boone's brief description, and shortly thereafter, Wolff (1961a, b) recognized that his taxon actually represented the poorly described *Probeebei mirabilis*, which he then redescribed in considerable detail, showing that it really was a hermit crab which he classified in the Paguridae. *Probeebei* was later placed in the Parapaguridae by de Saint Laurent (1972).

Probeebei mirabilis Boone, 1926
(Figs 2B-D, 3B)

MATERIAL EXAMINED. — For discussion purposes, the following diagnosis of *P. mirabilis* is presented, based on examination of specimens obtained during the US *Albatross* and Danish *Galathea* expeditions, as follows: 18 ♂♂, 20 ♀♀, 7 juveniles (USNM 119893-119897, 267810); 1 ♀, 2 juveniles (ZMK).

DISTRIBUTION. — Eastern Pacific: from south of Cocos Island to off southwest of Galapagos; 1145 to 4775 m.

HABITAT. — Apparently free-living.

REMARKS. — De Saint Laurent (1972) inaccurately indicated that the holotype of this species was from the Indian Ocean. The holotype was actually collected during the *Arcturus* Oceanographic Expedition (stn 74-OT4, 60 miles south of Cocos Island, 04°50'N - 87°00'W, 1145 m, 30.V.1925), and as pre-

viously mentioned is deposited in the American Museum of Natural History, New York (AMNH 12397).

Diagnosis

Eleven pairs of phyllobranchiate gills. Shield and posterior carapace partially fused, well calcified, spinose. Rostrum well-developed, elongate, and spinose; frequently strongly recurved upwardly. Branchiostegite moderately calcified, spinose. Shield marked by deep membranous cervical groove and linea transversalis. Posterior carapace spinose; cardiac sulci extending posteriorly and converging at midpoint of posterior margin; lateral margins broadly rounded.

Ocular peduncles with small dorsal spine proximally. Ocular acicles considerably reduced (Fig. 3B), marked by small spine. Epistome unarmed.

Antennular and antennal peduncles distinctly overreaching eyestalks. Fourth segment of antennal peduncle armed with distolateral and distomesial spines.

Chelipeds dissimilar in size, right not markedly larger than left. Ambulatory legs very long, slender, spinose; second distinctly longer than first. Fourth pereopod (Fig. 2B) semichelate, lacking rasp on propodus. Fifth pereopod chelate. Thoracic sternite of chelipeds narrow (Fig. 2D). Sternites of second and third pereopods moderately broadened. Sternites of fourth and fifth pereopods each consisting of transverse rod subdivided in midline, that of fifth narrow and widely separated from preceding sternite.

Abdomen (Fig. 2B-D) arched under body so ventral surface of telson faces sternite of fifth pereopods; tergites well-calcified, second to fifth spinose and with well-developed pleura. Uropods and telson (Fig. 2D) symmetrical or nearly so. Uropodal exopod and endopod slender, with weakly developed rasp consisting of rows of small corneous spines. Telson subrectangular.

Males with abdominal tergites symmetrical (Fig. 2C, D); with paired first pleopods modified as gonopods; lacking second to fifth pleopods. Females with second to fifth abdominal tergites asymmetrical (Fig. 2B), left pleura larger than right and covering eggs; with unpaired left biramous second to fifth pleopods.

COMPARISON OF *Tylaspis* AND *Probeebei*

Similarities

Tylaspis anomala and *Probeebei mirabilis* share the following characters: gill structure (phyllobranchia); partially fused and calcified shield and posterior carapace; well-developed rostrum; reduced ocular acicles; unarmed epistome; weakly dissimilar chelipeds; long, spinose ambulatory legs, with second pair distinctly longer than first; fourth pereopod lacking propodal rasp, with strong ventrodistal spine on propodus; symmetrical uropods and telson, with uropodal exopod and endopod having weakly developed rasps; and deep-water habitat. Both species exhibit a similar development of the second to fourth sternites (Figs 2D, 4G), which consists of plates that are broader than in other parapagurids.

Differences

Tylaspis anomala and *Probeebei mirabilis* differ in a number of features. No sulci are visible on the posterior carapace of *T. anomala*, although as previously mentioned the raised dorsomedian or cardiac region appears to be marked by a cardiac sulci. The cardiac sulci are clearly defined in *P. mirabilis*. The rostrum is prominent in both *T. anomala* and *P. mirabilis*, but is more so in the latter where it is spinose and often strongly recurved upwards. The ocular acicles are considerably reduced, unarmed, in *T. anomala* (Fig. 3A); the acicles are similarly reduced in *P. mirabilis*, but are marked by a small spine (Fig. 3B). The most striking differences between the two species, however, can be seen in the abdomen. The abdomen in *T. anomala* is slightly twisted to the right (Fig. 1), and membranous except for a moderate calcification of the tergite of the first somite and pleura of the second; adult males have paired first and second gonopods, and paired asymmetrical third to fifth (Fig. 6); adult females lack first and second pleopods, and have paired, asymmetrical third to fifth pleopods (Fig. 7E-H). In contrast, the abdomen of *P. mirabilis* has well-calcified first to fifth tergites; the tergites are symmetrical in males but asymmetrical in females, and armed with spines (Fig. 2B-D); adult males have no pleopods except for paired first, and adult females have unpaired left second to fifth.

PLEOPOD DEVELOPMENT

Pleopod development from larval to adult stages is an aspect that has been insufficiently studied in paguroids in general (see review in Lemaitre & McLaughlin 1992). It is commonly assumed that the megalopal pleopods are the same morphological structures seen in the adult. No anomurans have first pleopods in the megalopa. When juvenile or adult hermit crabs have first pleopods, it has been shown that these arise as new structures modified as gonopods and not from pre-existing pleopods (Provenzano & Rice 1966; Lemaitre & McLaughlin 1992). In the lithodid *Lithodes maja* (Linnaeus, 1758), Sandberg & McLaughlin (1997) have documented the development of paired first and unpaired second to fifth pleopods in females. They observed that in this lithodid, the megalopal pleopods are lost in the transition to the first juvenile stages, followed by gradual development of second to fifth left pleopods from the smaller juveniles (6.6 to 10.5 mm carapace length) to fully grown individuals (65.0 mm carapace length or greater). Paired first pleopods begin to appear relatively late in the juveniles stages when individuals reach about 50.0 mm carapace length.

Unfortunately no larval stages of *T. anomala* or *P. mirabilis* have been found, and only a few young or adult specimens are available. In the male specimens of *T. anomala*, no major differences in pleopods can be seen from the smallest (SL 6.5 mm) to the largest (SL 8.7 mm) specimens (Fig. 6). However, in females, development can be gleaned from differences in pleopod condition between the smallest (SL 5.9 mm; Fig. 7A-D) presumably young, and largest (SL 8.0 mm; Fig. 7E-H) presumably adult specimens. In both females the left second to fifth are similarly biramous, except for a greater development of the rami in the larger female; the right second to fifth pleopods are biramous in the young specimen, and short, uniramous (bud-like) in the adult specimen. Thus, based on the limited material available, it appears that a process of reduction occurs on the right side, whereas increased growth occurs on the left side. Whether or not these pleopods represent appendages that have reappeared after the loss of megalopal pleopods (such as reported for *Lithodes maja* by Sandberg & McLaughlin 1997), cannot be determined with the limited material available. At least in males, however, development of first and second pleopods does seem to occur secondarily as the individual matures.

Males of *P. mirabilis* develop only paired first pleopods modified as gonopods during the juvenile crab stages. As described by Wolff (1961b: 22, fig. 8, table 1), young males have paired uniramous (bud-like) second to fifth pleopods; adults have only one pair of pleopods, the first. In females of *P. mirabilis* development proceeds on the left second to fifth, from uniramous in the young to biramous in adults; on the right second to fifth, from uniramous in the young to loss or "scars" in adults. Again, the bud-like pleopods observed in juveniles could possibly represent appendages that are reappearing after the loss of megalopal pleopods. Reduction of these appendages continues in males until there is total absence in the adults. Females, however, loose only those on the right side, while those on the left develop into the egg-carrying appendages of the adults. The first pleopods of the male *P. mirabilis* develop as sexual appendages as the animal matures.

HABITAT

Tylaspis anomala and *P. mirabilis* live exclusively in deep waters (typically near 4000 m) of the Pacific. Of benthic decapods, these two species are considered among those that occur the deepest (Wolff 1960a; de Saint Laurent 1972). As previously mentioned, *T. anomala* uses an anemone to protect its abdomen. Although live specimens of *T. anomala* have not been observed, it appears from preserved specimens that, in life, part of the abdomen is bent under the body (see Borradaile 1916: 124, fig. 13; Wolff 1961b: 27, fig. 11). *P. mirabilis* is considered to be free-living, *i.e.* does not use a shell or other means of protecting its abdomen (Wolff 1961a, b), and also carries part of the abdomen bent under the body. A number of lots of *P. mirabilis* have been examined, and none contain evidence of housing or an associated organism as mode of protection. However, the morphology of the fourth pereopod of *P. mirabilis* (Fig. 2B) is virtually identical to that of *T. anomala*. Both exhibit on the propo-

dus of this appendage a strong ventrodistal spine that, at least in *T. anomala*, is clearly an adaptation for grasping an anemone (Fig. 4E). It is conceivable, therefore, that *P. mirabilis* may similarly use its fourth pereopod to grasp a protective organism or housing yet to be found with specimens of this species.

RELATIONSHIPS AND EVOLUTIONARY COMMENTS

Tylaspis anomala appears to be more closely related to *P. mirabilis* than to any other parapagurid. These two crab-like species exhibit virtually identical morphological developments on the cephalothorax and its appendages, and have similar modes of life. As previously mentioned, the only marked difference between the two can be found in the abdomen (degree of calcification, symmetry, and pleopod arrangement). The two are presumed to represent advanced forms that have evolved as result of the abandonment by their ancestors of shell use or other means of protection (Wolff 1961b). The traditional view used to explain paguroid abdominal modifications (*e.g.* asymmetry, loss of right pleopods, membranous condition) is based on the assumption that such modifications are the result of hermit crabs occupying dextrally coiled shells (*e.g.* Boas 1880, 1924; Henderson 1888; Bouvier 1894, 1897; Perez 1934; Russell 1962; Richter & Scholtz 1994). Thus, the premise has been that hermit crabs were first asymmetrical animals that lived in shells. Presumably, in carcinized forms such as *T. anomala* and *P. mirabilis*, abdominal asymmetry was retained from shell-dwelling ancestors, and cephalothoracic and tergite calcification evolved secondarily as a specialization for a free-living existence. The scarcity of calcareous shells at depths where *T. anomala* and *P. mirabilis* live might be cited as a limiting factor that has influenced the evolution of the abdomen in these two forms. However, other parapagurids (*Parapagurus* sp.) with a more conventional hermit crab morphology, live abundantly at similar depths, and do use for housing zoanthids that grow in a dextrally coiled fashion that imitates gastropod shells. Given the morphological characteristics of the cephalothorax and abdomen, and apparent lack of shell-carrying behavior of *T. anomala*, it is difficult to explain using traditional views of hermit crab evolution, why its abdomen is membranous (except for weak calcification of the first tergite and second pleura) and still has paired pleopods. Equally problematical is to attempt to explain why in *P. mirabilis* only females have asymmetrical tergites (Fig. 2B) and unpaired left pleopods, whereas males have symmetrical tergites (Fig. 2C, D) and pleopods (first). An alternative explanation might be that the asymmetry in abdominal tergites and pleopod condition in females of *P. mirabilis* represent a reproductive modification to egg-carrying, rather than a morphological trait retained from a shell-carrying ancestor.

Acknowledgements
With great admiration I dedicate this study to Alain Crosnier, whose iron will, outstanding editorial work, and perseverance in having the rich New Caledonia samples (and many others from the Indo-Pacific that he has obtained) studied by scientists from around the world, is paying off with the discovery of a remarkable fauna that is changing our views of the biogeography and evolution of crustaceans. I thank him for giving me the opportunity to study the specimens of this interesting and unique hermit crab, as well as for his help and advice in many matters (not always about crustaceans), and generous hospitality during trips to his laboratory in Paris. Dmitry Zhadan kindly supplied valuable information on the Russian material deposited in the ZMUM; Paul Clark arranged for the loan of type material from NHM, and Torben Wolff for the loan of specimens of *Probeebei mirabilis* from ZMK. Patsy A. McLaughlin and Tomoyuki Komai provided very useful criticism to the manuscript.

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A new genus of Eusiridae (Crustacea, Amphipoda), associated with the abalone *Haliotis rubra* Leach, in south-eastern Australia

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ABSTRACT
A new genus and species of eusirid amphipod, *Haliogeneia crosnieri*, is described from south-eastern Australia. It appears to be most closely related to the southern temperate and subantarctic genus *Gondogeneia* J. L. Barnard, 1972. *Haliogeneia crosnieri* n.sp. has highly modified gnathopods and has only been found in association with the abalone *Haliotis rubra* Leach.

MOTS CLÉS
Crustacea,
Amphipoda,
Eusiridae,
Haliogeneia,
nouveau genre,
nouvelle espèce,
commensale,
Gastropoda,
Haliotis,
Australie tempérée.

RÉSUMÉ
Un nouveau genre d'Eusiridae (Crustacea, Amphipoda), associé à l'ormeau Haliotis rubra *Leach, dans le Sud-Est de l'Australie.* Une nouvelle espèce d'Amphipode Eusiridae d'un nouveau genre, *Haliogeneia crosnieri*, est décrite du sud-est de l'Australie. Ce genre est étroitement apparenté à *Gondogeneia* J. L. Barnard, 1972, des eaux tempérées et subantarctiques. *Haliogeneia crosnieri* n.sp. a des gnathopodes très modifiés et a été trouvé seulement en association avec l'ormeau *Haliotis rubra* Leach.

INTRODUCTION

Eusirids are mainly free-living amphipods mostly found among shallow-water algae in boreal, temperate and subantarctic areas. There are very few records of eusirids in association with other animals. Griffiths (1974) and Branch (1975) have reported *Calliopiella michaelseni* Schellenberg, 1925, living under the shells of various species of limpet, *Patella* spp., in southern Africa. In this paper we describe a new genus and species of eusirid amphipod, *Haliogeneia crosnieri*, living in association with the abalone *Haliotis rubra* Leach in south-eastern Australia. *Calliopiella* and *Haliogeneia* do not appear to be closely related so their associations with limpets and abalone, although rare in eusirid amphipods, appear to be independent events.

The following abbreviations are used on the plates:

A	antenna;
G	gnathopod;
H	head;
E	epistome;
EP	epimeron;
MD	mandible;
MP	maxilliped;
MX	maxilla;
P	pereopod;
T	telson;
U	uropod;
l	left;
r	right.

Material is deposited in the Australian Museum, Sydney (AM).

Haliogeneia n.g.

TYPE SPECIES. — *Haliogeneia crosnieri* n.sp.

ETYMOLOGY. — From the abalone genus *Haliotis* and "geneia", the stem for pontogeneid-type eusirids.

DIAGNOSIS

Head: eyes reniform. Antenna 1: peduncular article 3 not produced apicoventrally; accessory flagellum scale-like. Epistome: not produced. Mandible: molar conical, weakly triturative. Maxilla 1: palp well-developed, article 1 shorter than article 2; article 3 shorter than article 2. Maxilla 2: inner plate as broad as outer plate; inner plate without oblique setal row, with 2 plumose setae near margin. Maxilliped: outer plate small, not reaching apex of palp article 3. Gnathopods 1 & 2: subchelate, similar, stout, gnathopod 1 slightly smaller than gnathopod 2; carpi shorter than propodi with small lobe on posterior margin; dactyli highly modified, scooped-spatulate. Coxae 1-4: large, similar length. Sternal gills absent. Pereopods 5 to 7: meri not strongly produced posteriorly; dactyli with well-developed subterminal seta. Pleonites 1 to 3 smooth. Uropods 1 and 2: with lateral robust setae. Uropod 3: rami subequal in length. Telson cleft.

REMARKS

Haliogeneia is very similar to *Gondogeneia* J. L. Barnard, 1972. The main differences between these genera are in the molar, which is reduced and conical in *Haliogeneia* but well-developed and columnar in *Gondogeneia*, and in the dactyli of gnathopods 1 and 2, which are of a highly-derived scooped-spatulate form in *Haliogeneia*.
Haliogeneia does not appear to be closely related to *Calliopiella* Schellenberg, 1925, the only other eusirid genus known to have an association with gastropod molluscs. In addition to the modified molar and gnathopods, *Haliogeneia* differs from *Calliopiella* in the absence of an oblique setal row on the inner plate of maxilla 2, in the much more setose uropods and in the cleft telson.

Haliogeneia crosnieri n.sp.
(Figs 1-5)

TYPE MATERIAL. — **Australia.** Second Pressure Reef, south of Bunga Head, New South Wales, approximately 36°36'S - 150°03'E, 13 m depth, in association with the abalone *Haliotis rubra*, X.1995, coll. E. Koellner: holotype, ♀ 11.5 mm (AM P49724); paratype, ovig. ♀, 10.0 mm (AM P49725); paratype, ovig. ♀, 10.5 mm (AM P49726); paratype ♀ (AM P49728); 18 paratypes (AM P49727).

ETYMOLOGY. — This species is named to honour Alain Crosnier who for years has been the main facilitator for the description of the South Pacific and western Indian Ocean marine fauna. We thank him for allowing us to study the lysianassoid amphipod collections under his care. His generosity and encourage-

ment gave us the opportunity to study and learn from collections which were available in no other way.

Description

Based on holotype female. Colour: when live, "luminous" blue (according to collector of type material, E. Koellner). Head: slightly deeper than long; lateral cephalic lobe subquadrate, slightly produced; anteroventral margin vertical, rounded; rostrum small; eyes medium, slightly reniform. Antenna 1: medium length, 0.25 times body; peduncular article 1 longer than (1.6 times) article 2; article 2 longer than (2.0 times) article 3; article 3 shorter than (0.3 times) article 1; accessory flagellum present, scale-like; flagellum 31-articulate, with groups of setae along posterior margin of most articles; calceoli absent. Antenna 2: peduncular article 3 short, length 1.4 times depth, without flange on anterolateral margin; article 5 long, length 1.3 times depth; flagellum longer than peduncle, more than 33-articulate; calceoli absent.
Epistome and upper lip: fused, not produced. Mandibles: incisors asymmetrical, left with six serrations, right with ten serrations; laciniae mobilis asymmetrical, left with eleven serrarions, right with four serrations; accessory setal rows, left with four serrate setae, right with three serrate setae; molars conical, with reduced triturating surface, with one long pappose seta; article 2 long, 2.0 times as long as wide, 1.4 times article 3; article 3 short, 2.7 times as long as wide. Lower lip: inner lobes absent. Maxilla 1: inner plate small, subovate, with three pappose

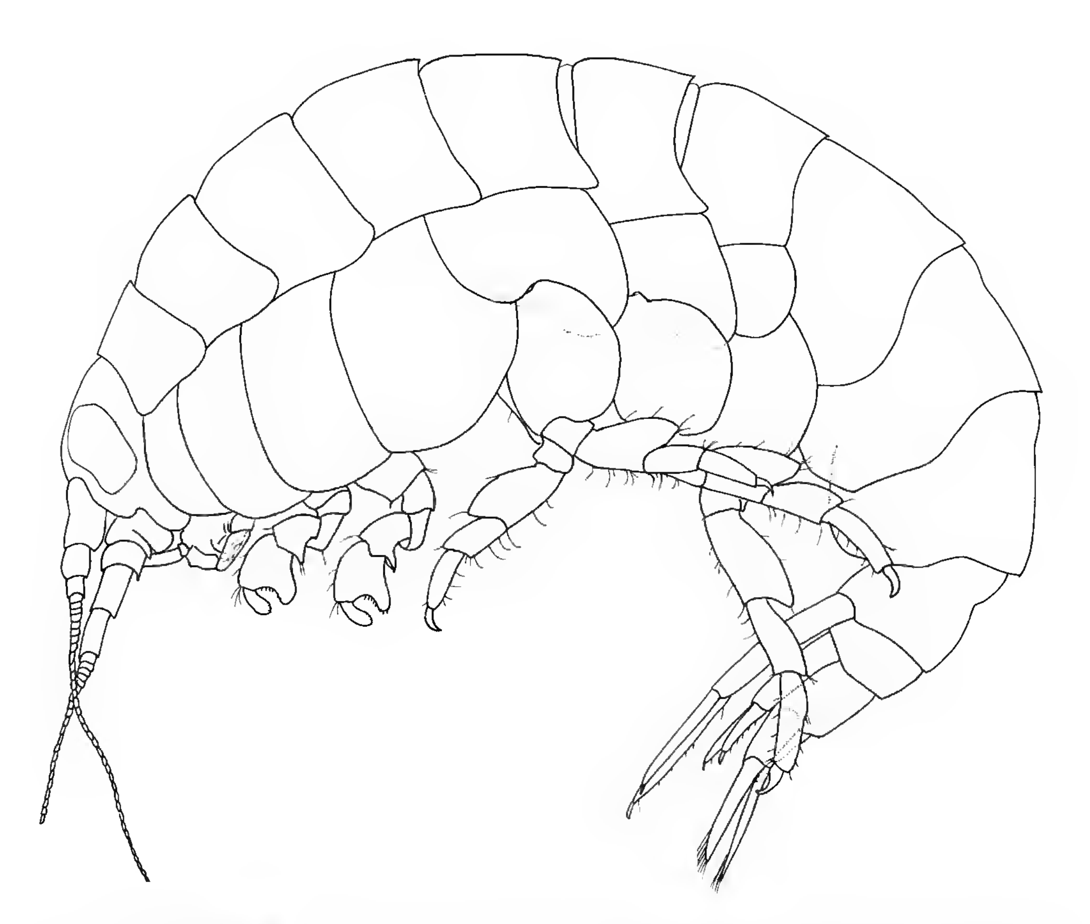


Fig. 1. — *Haliogeneia crosnieri* n.sp., holotype ♀, 11.5 mm (AM P49724), south of Bunga Head, New South Wales, Australia.

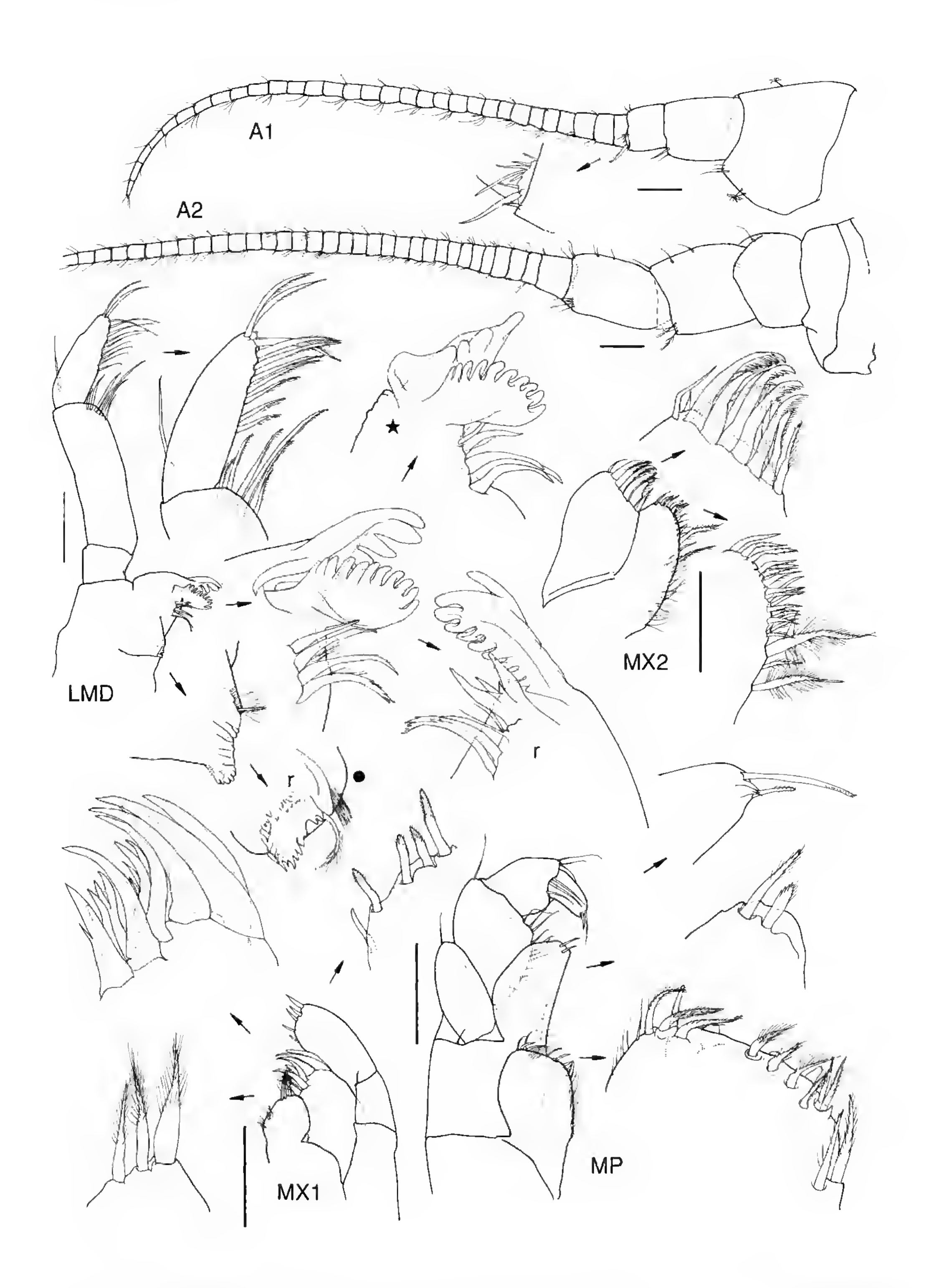


FIG. 2. — *Haliogeneia crosnieri* n.sp., holotype ♀, 11.5 mm (AM P49724); * paratype ♀, 10.0 mm (AM P49725); • paratype ♀, 10.5 mm (AM P49726); south of Bunga Head, New South Wales, Australia. Scale bars: 0.2 mm.

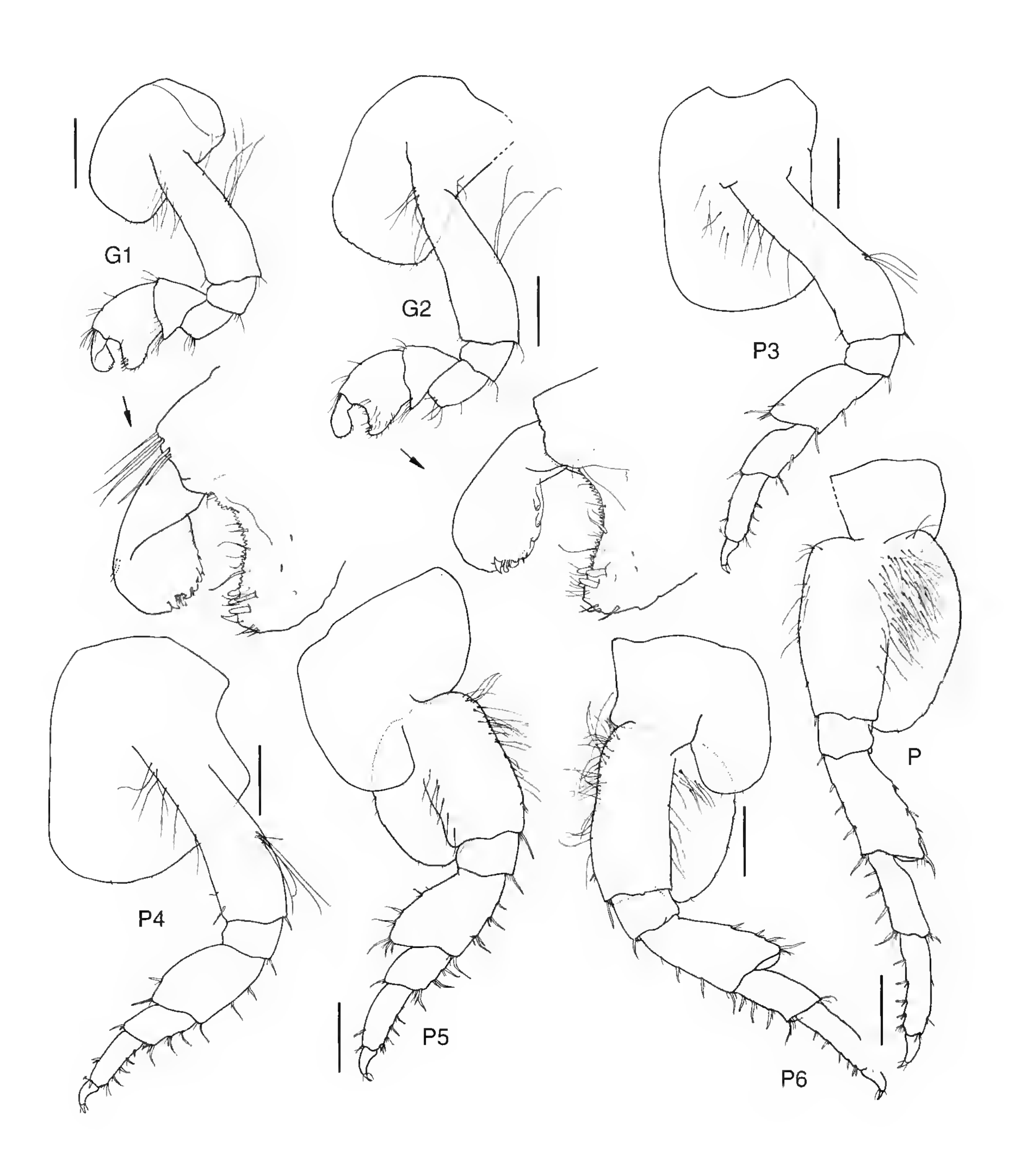


FIG. 3. — *Haliogeneia crosnieri* n.sp., holotype ♀, 11.5 mm (AM P49724); south of Bunga Head, New South Wales, Australia. Scale bars: 0.5 mm.

setae; outer plate with eleven strong setal-teeth; palp 2-articulate, article 1 0.6 times article 2, article 2 with five apical setae, without subterminal setae. Maxilla 2: inner and outer plates broad; inner plate with apical slender setae, with medial slender setae, without oblique row of slender setae, medial margin with two large pappose setae; outer plate with apical robust setae, without medial slender setae. Maxilliped: inner plate small, just reaching base of outer plate, subrectangular, with three apical nodular setae and nine apical pappose seate, with two apicomedial pappose setae, without oblique setal row, without robust setae or submarginal setae along medial margin; palp large, 4-articulate; article 2 broad, with setose inner margin; article 3 short, without setose inner margin; dactylus spatulate, unguis absent.

Gnathopod 1: subchelate, slightly smaller than gnathopod 2; coxa deeper than wide, anteroventral margin rounded; basis long, subrectangular, with tuft of five long, slender setae on posterior margin; carpus subtriangular, short, length 0.9 times breadth, shorter than (0.7 times) propodus, with a small, acutely-produced lobe; propodus broad, length about as long as width, produced posterodistally, palm slightly obtuse, concave, margin lined with short spines, with a single robusr seta near inner base of dactylus, with several posterodistal robust setae; dactylus broadened distally, scooped-spatulate. Gnathopod 2: subchelate; coxa deeper than wide; basis long, subrectangular, with tuft of four long, slender setae on posterior margin; carpus subtriangular, short, length abour 0.9 times breadth, shorrer than (0.7 times) propodus, with a small, acutely-produced lobe; propodus broad, about as long as wide, produced posterodistally, palm slightly obtuse, concave, margin lined with short spines, with a slender seta near inner base of dactylus,

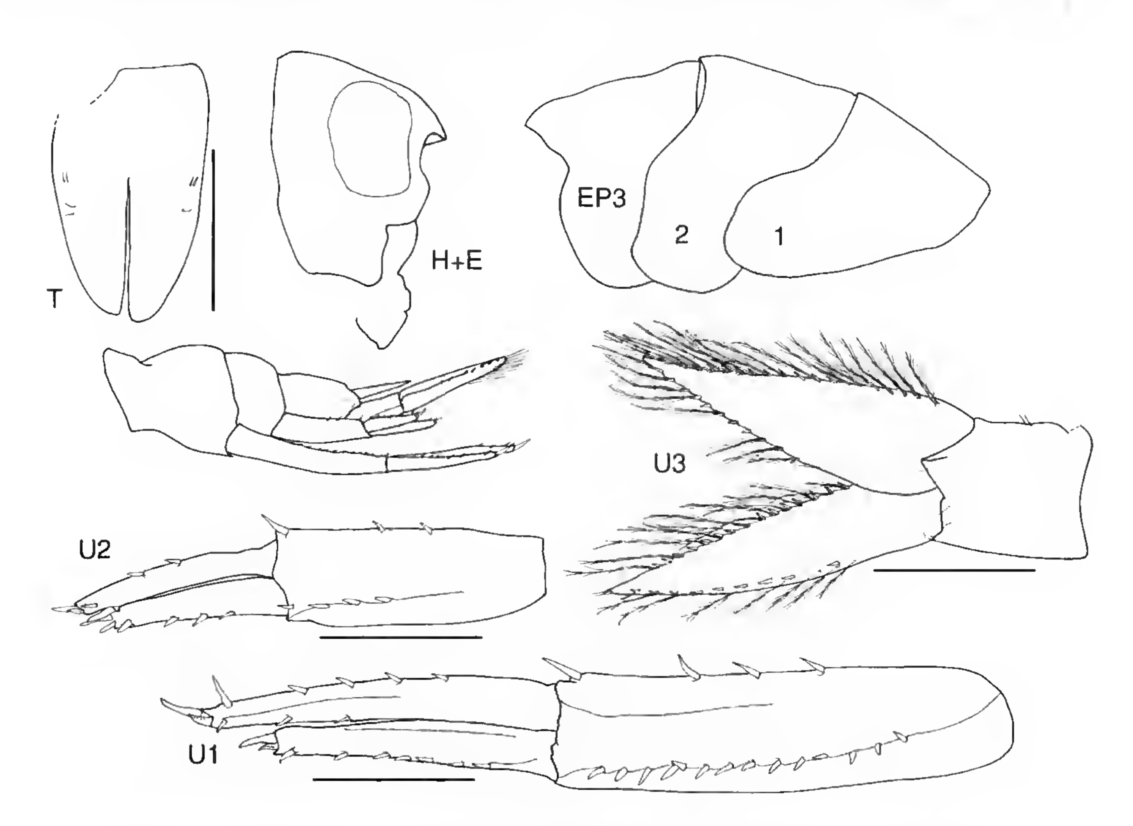


Fig. 4. — *Haliogeneia crosnieri* n.sp., holotype ♀, 11.5 mm (AM P49724), south of Bunga Head, New South Wales, Australia. Scale bars: 0.5 mm.

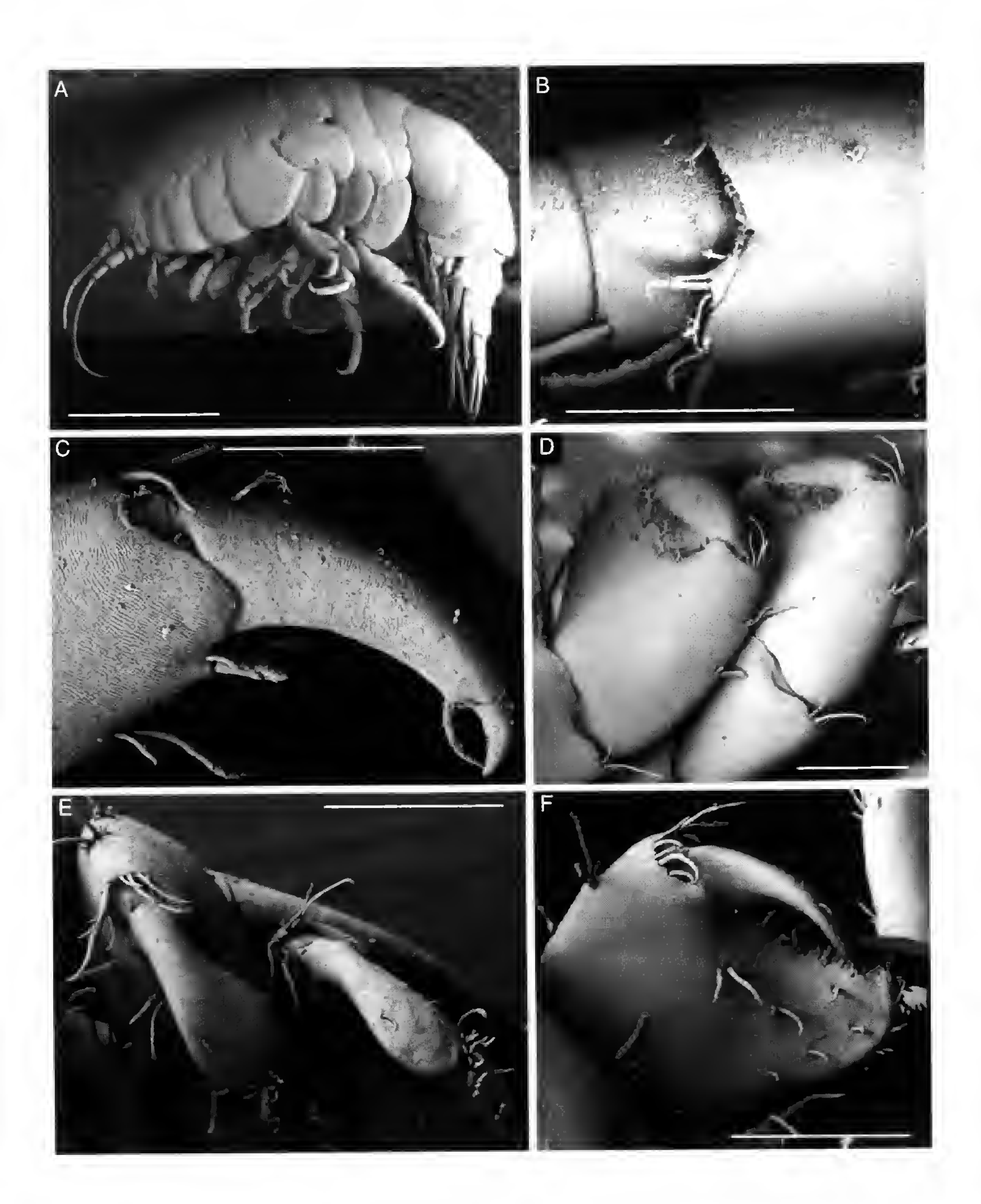


FIG. 5. — *Haliogeneia crosnieri* n.sp., paratype ♀ (AM P49728); **A**, whole animal; **B**, medial view of antenna 1 showing scale-like accessory flagellum; **C**, dactylus of peraeopod 6; **D**, lateral view of gnathopods 1 and 2; **E**, anterior surface of spatulate dactyli of gnathopods 1 and 2; **F**, medial view of propodus and dactylus of gnathopod 1. Scale bars: A, 2 mm; B, 100 µm; C, 100 µm; D, 200 µm; E, 200 µm; F, 200 µm.

with several posterodistal robust setae; dactylus broadened distally, scooped-spatulate.

Pereopod 3: coxa deeper than wide; basis long, subrectangular, anterior margin with five long slender setae, posterior margin with tuft of three long slender setae; merus long, length 1.6 times breadth, anterior margin slightly expanded; carpus long, length 1.8 times breadth; propodus length 2.7 times breadth, with five setae along posterior margin. Pereopod 4: coxa slightly deeper than wide, with slightly developed posteroventral lobe; basis long, subrectangular, anterior margin with seven long slender setae, posterior margin with tuft of five long slender setae; merus long, length 1.5 times breadth, anterior margin slightly expanded. Pereopod 5: coxa about as wide as deep, with posteroventral lobe; basis expanded posteriorly, with long slender setae along anterior margin; merus long, length 1.4 times breadth, expanded posterodistally; carpus short, subquadrate, length 1.2 times breadth; propodus subrectangular, length 2.6 times breadth. Pereopod 6: coxa about as wide as deep, with posteroventral lobe; basis expanded posteriorly, with slender setae along anterior margin; merus long, length 1.6 times breadth, expanded posterodistally; carpus short, length 1.8 times breadth; propodus subrectangular, length 3.2 times breadth. Pereopod 7: coxa small, about as wide as deep, not lobed; basis expanded posteriorly, with slender setae along anterior margin; merus long, length 1.7 times breadth, expanded posterodistally; carpus long, length 2.6 times breadth; propodus subrectangular, length 4.0 times breadth. Pereopods 3 to 7: dactylus short, curved, with prominent subterminal seta.

Epimeron 3: posteroventral corner broadly rounded. Uropod 1: peduncle with fourteen dorsolateral robust setae and four dorsomedial robust setae; inner ramus slightly longer than outer; outer ramus with seven lateral and two apical robust setae; inner ramus with three medial, five lateral and two apical robust setae. Uropod 2: peduncle with four dorsolateral robust setae and three dorsomedial robust setae; rami subequal in length; outer ramus with four lateral and two apical robust setae; inner ramus with two lateral, and three apical robust setae. Uropod 3: peduncle short, without dorsolateral or dorsomedial robust setae; rami subequal in length, lined with plumose setae; outer ramus with nine lateral and fifteen medial robust setae; inner ramus with nine medial and eleven lateral robust setae. Telson: moderately cleft (56%), longer than broad, length 1.7 times breadth, without dorsal robust setae, with sparse dorsal slender setae, distal margins rounded, without apical setae.

REMARKS

Haliogeneia crosnieri appears to be a specialized *Gondogeneia* which has developed some kind of association with the abalone *Haliotis rubra*. Mr E. Koellner (commercial abalone diver) has observed specimens falling off the shells when they are brought on deck. There is some indication that it may be living on the mantle of the abalone. The dactyli of the gnathopods have a slightly scooped spatulate shape. Unfortunately, we have no information about how they are used.

There is only one male specimen (8.0 mm) in the collection; there are no calceoli on its antennae.

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Hermit crabs of the genus *Nematopagurus* (Crustacea, Decapoda, Paguridae) from south-eastern South Africa and Madagascar: new records and new species

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KEY WORDS
Hermit crabs,
Nematopagurus,
new species,
new records,
southern Africa.

ABSTRACT
As part of an ongoing review of the hermit crab genus *Nematopagurus* A. Milne Edwards *et* Bouvier, a small, but diverse collection of specimens from eastern South Africa and Madagascar is reported on. Of the seven species present, four represent new taxa, two from South Africa and two from Madagascar. Three species are new records for South Africa.

MOTS CLÉS
pagures,
Nematopagurus,
nouvelle espèce,
nouveau signalement,
Afrique du Sud.

RÉSUMÉ
Pagures du genre Nematopagurus *(Crustacea, Decapoda, Paguridae) du Sud-Est de l'Afrique du Sud et de Madagascar : nouvelles découvertes et nouvelles espèces.* Au cours d'une révision du genre de pagure *Nematopagurus* A. Milne Edwards *et* Bouvier, une petite mais riche collection de l'est d'Afrique du Sud et de Madagascar a été examinée. Parmi les sept espèces présentes, quatre sont nouvelles, deux d'Afrique du Sud et deux de Madagascar. Trois espèces sont signalées pour la première fois d'Afrique du Sud.

INTRODUCTION

During the course of an ongoing review of the hermit crab genus, *Nematopagurus* A. Milne Edwards *et* Bouvier, 1892, a small, but very interesting collection of specimens of this genus from the eastern coast of South Africa was made available to the author. Given the relatively close proximity of this collection to Madagascar, long the duty station of ORSTOM's eminent biologist, Dr Alain Crosnier, to whom this volume is dedicated, it seemed only fitting that these species of *Nematopagurus*, and those from Madagascar, collected by Dr Crosnier himself, be dealt with separately.

Nematopagurus was established by A. Milne Edwards & Bouvier (1892) for the lone Atlantic species *Nematopagurus longicornis* A. Milne Edwards *et* Bouvier, 1892. From the Indo-Pacific, Alcock (1905a, b) described four new species and transferred *Catapagurus muricatus* Henderson, 1896 to *Nematopagurus*. Alcock's monograph (1905b) provided the principal source of information on the genus for the following sixty years. Since the mid 1960's, nine additional species have been described in, or assigned to *Nematopagurus*, all from the Pacific and/or Indian Oceans, and a considerably large number of undescribed species remain to be added. Many species of *Nematopagurus* are superficially quite similar, and only through the use of a suite of morphological characters can correct identifications be made. Alcock's (1905b) species descriptions provided only very general information; however, carcinologists often have been reluctant to establish new taxa even when faced with clear discrepancies (*e.g.* Kemp & Sewell 1912; Miyake 1978; Haig & Ball 1988).

Nematopagurus is characterized by the presence of eleven pairs of biserial phyllobranchiate gills (*cf.* McLaughlin & de Saint Laurent 1998); a broadly rounded rostral lobe, generally subequal chelipeds; semichelate fourth pereopods, each with a single row of corneous scales in the propodal rasp; males with a long filamentous right sexual tube orientated from right to left across the ventral thorax, and short left sexual tube; and females with paired first pleopods modified as gonopods.

None of the faunistic reports of hermit crabs from Madagascar (*e.g.* Hoffmann 1874; Lenz & Richters 1881; Lenz 1910; Gravier 1920; Dechancé 1964) mention species of *Nematopagurus*; however, two species, both undescribed, are represented in the ORSTOM collections. In contrast, Kensley (1969) reported two species of *Nematopagurus* in south-east South African waters, one as *N. gardineri* Alcock, 1905, the second as *N. squamichelis* Alcock, 1905. Neither are conspecific with Alcock's taxa. A third species, identified only as "? *Nematopagurus* sp." based on a single female specimen was later recorded by Kensley (1978). All three species were collected off Natal at depths between 138 and 347 m, and all are represented in the present material.

Kensley's (1969) *N. gardineri* is the undescribed species, *N. meiringae* n.sp.; his *N. squamichelis* is conspecific with the Madagascar species described herein as *N. crosnieri* n.sp. Kensley's (1978) specimen of "? *Nematopagurus* sp." was returned to the collections of the Zoological Museum, University of Copenhagen (ZMUC). It has been reexamined and has proved to represent *N. spinulosensoris* McLaughlin *et* Brock, 1974, described originally from the Hawaiian Islands, but reported recently from the Red Sea (Türkay 1986), Indonesia (McLaughlin 1997), and the Seychelles (McLaughlin & Hogarth 1998). Additional specimens of this species were collected during the *Meiring Naude* cruises. A second species from Madagascar, and one from off North Zululand, also are new to science. They are described herein as *N. chauseyensis* n.sp. and *N. kosiensis* n.sp. respectively. *Nematopagurus diadema* Lewinsohn, 1969, previously known only from the Red Sea, is formally recorded for the first time off North Zululand, although Witherington (1973) documented its presence in the Mozambique Channel in his unpublished dissertation. *Nematopagurus holthuisi* McLaughlin *et* Hogarth (1998), a species recently described from the Seychelles, is also present in South African waters. A key to the local species is presented.

MATERIALS AND METHODS

Materials for this study have come primarily from cruises of the South African research vessel *Meiring Naude* in the region off south-eastern South Africa, and the French research vessel *Vauban* in waters off Madagascar. These have been supplemented by Kensley's (1969) specimens of *N.* "*gardineri*" and *N.* "*squamichelis*" collected by scientists during the seventh cruise of the RV *Anton Bruun* during the International Indian Ocean Expedition (IIOE) of 1964, and deposited in the South African Museum, Cape Town (SAM). For comparative purposes, the holotype of *N. gardineri* was borrowed from the University Museum of Zoology, Cambridge (UMZC). Holotypes and some paratypes of the new species have been deposited in the Muséum national d'Histoire naturelle, Paris (MNHN). As availability permitted, paratypes also have been deposited in the National Museum of Natural History, Smithsonian Institution, Washington D. C. (USNM) and South African Museum. Non-type materials remain in the author's personal collection (PMcL). One measurement, shield length (SL), measured from the tip of the rostrum, or midpoint of the rounded rostral lobe, to the midpoint of the posterior margin of the shield, provides an indication of specimen size. Terminology used in the diagnoses and descriptions generally follows that of McLaughlin (1974) with the exception of the fourth pereopod (after McLaughlin 1997) and telson (after McLaughlin & Forest 1997). The station designation CH indicates samples collected with a beam trawl.

KEY TO THE REGIONAL SPECIES

1. Diameter of cornea approximately equal to or exceeding peduncular length. Dorsal surfaces of carpi and palms of chelipeds with transverse rows of scutes 2

— Diameter of cornea appreciably less than peduncular length. Dorsal surfaces of carpi and palms of chelipeds without transverse rows of scutes 3

2. Dorsomesial margin of palm of right cheliped and dorsolateral margin of left chela each with small spines. Dactyls of ambulatory legs very long, exceptionally slender, distally curved and strongly twisted .... *N. chauseyensis* n.sp.

— Dorsomesial margin of palm of right cheliped and dorsolateral margin of left chela unarmed. Dactyls of ambulatory legs moderately long, not exceptionally slender, distally curved but not strongly twisted .... *N. crosnieri* n.sp.

3. Dorsal surfaces of palms of chelipeds each with large rosette of tubercles .... *N. diadema* Lewinsohn

— Dorsal surfaces of palms of chelipeds without large rosette of tubercles 4

4. Dorsal surfaces of chelae of both chelipeds covered with spines or spinules 5

— Dorsal surfaces of chelae of both chelipeds with median longitudinal row of spines 6

5. Spines of chelae with numerous spines modified by teardrop-shaped sensory structures .... *N. spinulosensoris* McLaughlin *et* Brock

__ Spines of chelae without numerous spines modified by teardrop-shaped sensory structures .... *N. holthuisi* McLaughlin *et* Hogarth

6. Right cheliped each with median longitudinal row of spines extending full length of palm; dorsal surface with long dense setae distally on palm and proximally on fixed finger, scattered long setae on remaining surfaces .... *N. meiringae* n.sp.

— Right cheliped each with median longitudinal row of spines only in proximal third of palm; dorsal surface with only scattered long setae, no dense setae distally on palm and proximally on fixed finger .... *N. kosiensis* n.sp.

Nematopagurus crosnieri n.sp.
(Fig. 1)

Nematopagurus squamichelis – Kensley 1969: 163, fig. 6a-d; not *Nematopagurus squamichelis* Alcock, 1905b.

MATERIAL EXAMINED. — **Madagascar.** *Vauban* stn CH 10, 12°43'S - 48°15'E, 360-345 m, 10.IV.1971, coll. A. Crosnier: holotype ♂ SL 6.8 mm (MNHN Pg 5537); paratypes, 1 ♂ SL 6.3 mm, 1 ovig. ♀ SL 6.1 mm (MNHN Pg 5538). — Stn CH 56, 23°36.3'S - 43°31.6'E, 395-410 m, 26.II.1973, coll. A. Crosnier: 1 ovig. ♀ SL 6.3 mm (USNM 276083). **South Africa.** *Anton Bruun* stn 370, 24°40'S - 35°28'E, 347 m, 18.VIII.1964: 2 ♂♂ SL 4.0, 4.5 mm, 1 ♀ SL 3.0 mm (SAM 19479).

TYPE MATERIAL. — The holotype is a male with shield length of 6.8 mm from Madagascar, *Vauban* station CH 10 (MNHN Pg 5537). The other specimens mentioned here are paratypes.

DISTRIBUTION. — South Mozambique Channel to off Cap d'Ambre, Madagascar; 347-410 m.

HABITAT. — Shell substrate.

ETYMOLOGY. — This species is dedicated to Alain Crosnier, esteemed friend and colleague, and exalted leader of "Crosnier's Cronies".

DESCRIPTION

Shield broader than long; anterior margin between rostral lobe and lateral projections weakly concave; anterolateral margins sloping; posterior margin truncate or rounded; surface with few sparse tufts of short setae laterally and anteriorly. Rostrum very broadly rounded, not produced beyond level of lateral projections. Lateral projections strongly developed beneath anterior margin; each with laterally directed spinule.

Ocular peduncles short, 0.55-0.60 length of shield; dorsal surfaces each with median tuft of stiff setae at base of cornea, dorsomesial surface with sparse tuft of setae; corneae strongly dilated, corneal diameter equal to or exceeding peduncular length. Ocular acicles small, triangular; terminating subacutely, with deeply concave dorsal surface and prominent submarginal spine.

Antennular peduncles moderately short, exceeding distal margins of corneae by 0.25-0.45 length of ultimate segments. Ultimate and penultimate segments with few scattered setae. Basal segment with acute spine on lateral face distally.

Antennal peduncles moderately short, overreaching distal margins of corneae by 0.20-0.35 length of fifth segments. Fifth and fourth segments with few scattered setae. Third segment with small spine at ventrodistal angle. Second segment with dorsolateral distal angle produced, terminating in acute spine, lateral and mesial margins with few stiff setae; dorsomesial distal angle with small spine. First segment unarmed. Antennal acicle moderately long, reaching beyond proximal half of ultimate peduncular segment; arcuate, terminating in acute spine; mesial margin with tufts of long stiff setae. Antennal flagella long, overreaching tip of right cheliped; occasionally few articles each with one or two very short setae or bristles, at least in proximal half.

Chelipeds subequal; right only slightly longer, but stouter than left, both moderately elongate. Dactyl slightly shorter to nearly equal to length of palm; cutting edge with three or four strong calcareous teeth proximally, corneous teeth distally, terminating in small corneous claw and

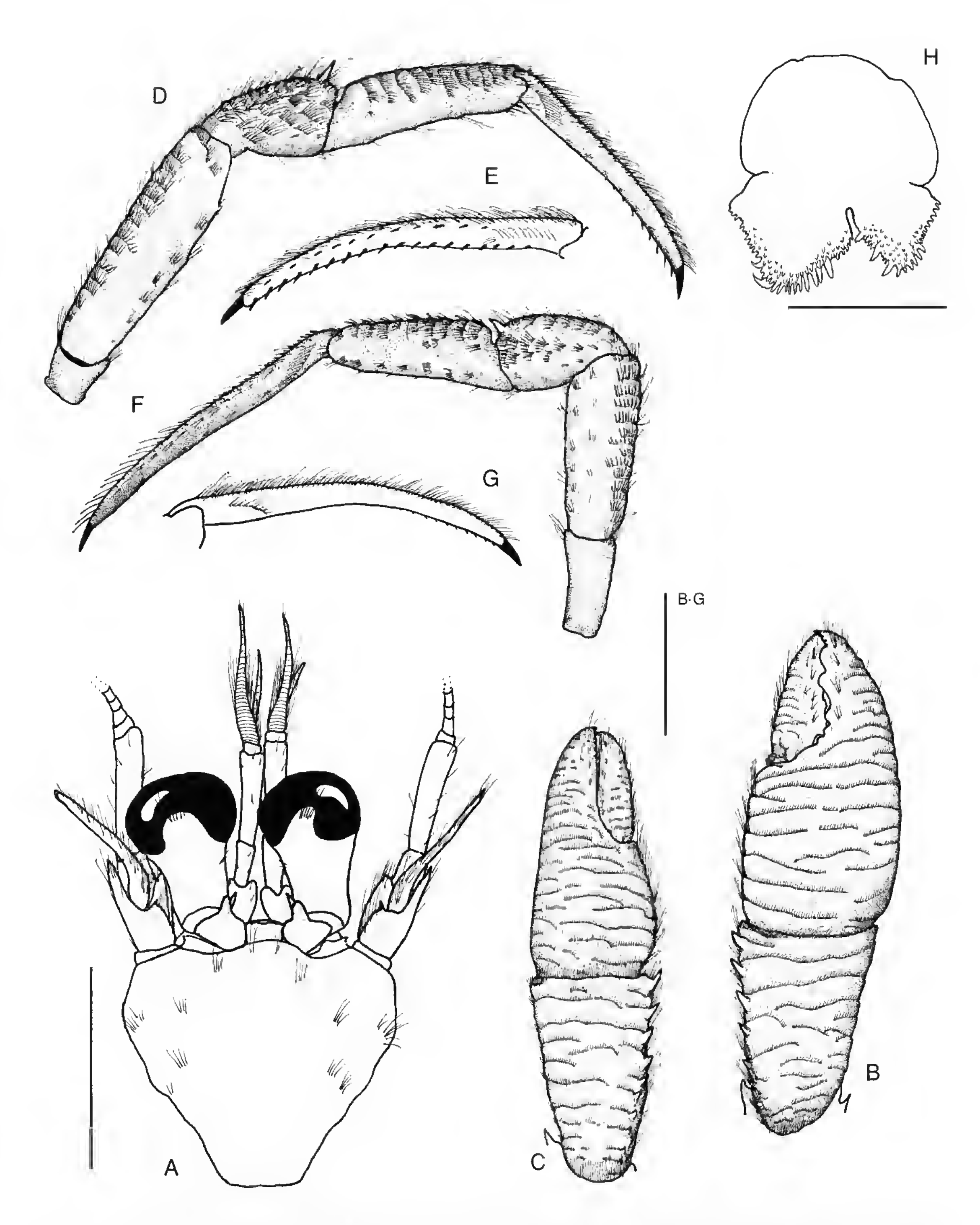


Fig. 1. — *Nematopagurus crosnieri* n.sp., paratype, ovigerous ♀ (SL 6.3 mm), *Vauban* stn CH 56 (USNM 276083); **A**, shield and cephalic appendages; **B**, carpus and chela of right cheliped (dorsal view); **C**, carpus and chela of left cheliped (dorsal view); **D**, right second pereopod (lateral view); **E**, dactyl of right second pereopod (mesial view); **F**, left third pereopod (lateral view); **G**, dactyl of left third pereopod (mesial view); **H**, telson. Scale bars: A, 5 mm; H, 2 mm; B-G, 1 mm.

slightly overlapped by fixed finger; dorsal surface with several low transverse scutes mesially and extending onto rounded dorsomesial margin, each with marginal row of short stiff setae, few tufts of short setae adjacent to cutting edge; mesial face with abundance of long setae. Palm 0.80 to nearly as long as carpus; dorsomesial margin not delimited; dorsal surface with eight or nine rows of partially to nearly complete transverse scutes continued onto lateral and mesial faces, each with marginal row of short stiff setae; proximal 0.75-0.80 of dorsal surface of fixed finger with moderately short transverse rows of scutes provided with marginal short stiff setae; distal 0.20-0.25 of dorsal surface with scattered tufts of setae; cutting edge with row of three or four strong calcareous teeth, small calcareous teeth near tip, terminating in small corneous claw; ventral surfaces of palm and fixed finger smooth, with few short transverse rows of long setae. Carpus approximately equal to length of merus; dorsodistal margin with row of uniformly short stiff setae; dorsomesial margin with row of strong spines; dorsal surface with complete or incomplete transverse scutes extending onto lateral and mesial faces and provided marginally with short stiff setae; dorsolateral margin not delimited; ventral surface with low protuberances and tufts of setae, occasionally small spine near ventrodistal margin. Merus subtriangular; dorsal margin, mesial and lateral faces all with transverse ridges and long stiff setae; ventrolateral margin with two widely-spaced spines in distal half, frequently few transverse ridges and stiff setae proximally; ventromesial margin with three widely-spaced spines, ventral surface with few low protuberances or ridges and tufts of setae. Ischium with small acute or blunt spine at ventrolateral angle.

Left cheliped usually reaching nearly to tip of dactyl of right; moderately slender. Dactyl slightly shorter to slightly longer than palm; cutting edge with row of small corneous teeth, terminating in small corneous claw and slightly overlapped by fixed finger; dorsomesial margin rounded, dorsal surface with tufts of short setae adjacent to cutting edge, rows of marginally setiferous scutes extending onto mesial face; ventral surface with few tufts of setae. Palm 0.65-0.80 length of carpus; dorsomesial margin rounded; dorsal surface, like that of right, with seven to nine transverse rows of complete or incomplete scutes, each extending onto lateral and mesial faces and provided with marginal row of short stiff setae; dorsal surface of fixed finger with several short transverse scutes, each with marginal fringe of short stiff setae; cutting edge with row of small calcareous teeth interspersed with corneous teeth. Carpus approximately 1,25 longer than merus; dorsodistal margin with uniform row of short stiff setae, dorsomesial margin with row of prominent spines, dorsolateral margin not delimited; dorsal surface with several complete or more frequently interrupted, marginally setiferous scutes extending onto lateral and mesial faces; ventral surface with low protuberances and tufts of setae. Merus subtriangular; dorsal surface with transverse ridges and stiff setae, distal margin with row of moderately long stiff setae; lateral and mesial faces with tufts of stiff setae; ventral surface with few low protuberances and tufts of setae; ventromesial margin with row of acute spines, decreasing in size proximally, ventrolateral margin with three or four spines distally and spinulose ridges in proximal half. Ischium with acute or blunt spine at ventrolateral angle.

Ambulatory legs slightly overreaching right cheliped. Dactyls 0.25 to twice length of propodi; in lateral view straight or slightly curved ventrally (third right); in dorsal view, slightly twisted; each terminating in strong corneous claw; dorsal surfaces each with very short transverse rows of small corneous spines and moderately short stiff setae; mesial faces each with row of corneous spinules dorsally and row of corneous spines at ventral margin, short row of setae in midline proximally; lateral faces each with arched row of setae in proximal fourth and row of sparse tufts of short setae near dorsal and ventral margins. Propodi 0.25-0.35 longer than carpi; dorsal surfaces each with row of short transverse ridges extending onto lateral faces and set with short stiff setae; mesial and lateral faces with few scattered setae (second) or with longitudinal row of sparse tufts of short setae near ventral margin (third); ventral surfaces with few widely-spaced sparse tufts of setae, one or two corneous spines at ventrodistal angle. Carpi 0.50-0.75 length of

meri; dorsal surfaces each with spine at dorsodistal angle, frequently one additional spine in proximal half on second pereopods, occasionally also on third right, and all with row of tufts of stiff setae; lateral faces each with several short oblique rows of stiff setae, ventral surfaces each with few scattered sparse tufts of setae; mesial faces glabrous or with few tiny tufts of very short setae. Meri laterally compressed; dorsal surfaces each with row of transverse ridges and stiff setae; lateral faces each with one or two longitudinal rows of short setae; mesial faces glabrous or with very few sparse tufts of short setae; ventral surfaces of second pereopods each usually with acute spine distally and three or four blunt or spinulose protuberances accompanied by sparse tufts of setae; third with tufts of setae. Ischia each with few setae dorsally and ventrally. Anterior lobe of sternite of third pereopods roundly subrectangular, with long stiff setae medially and/or on anterior margin.

Males with well-developed, elongate, filiform sexual tube on coxa of right fifth pereopod, left with sexual tube developed only as enlarged papilla protruding from gonopore. Telson with posterior lobes asymmetrical, subtriangular; separated by deep median cleft; terminal margins oblique, each with one or more rows of acute spines; lateral margins oblique, each with row of small subacute spines increasing in size toward outer angle; dorsal surface frequently spinulose near terminal margins.

COLOUR

Not known.

REMARKS

Kensley (1969) identified three specimens from the southern end of the Mozambique Channel (*Anton Bruun* stn 370, IIOE) as *Nematopagurus* "*squamichelis*" Alcock, 1905 presumably because of the "imbricating squamae" covering the chelae and carpi of the chelipeds. However, Kensley's (1969: fig. 6b, c) figures suggested a species more closely related to *Nematopagurus scutellichelis* Alcock, 1905b (pl. 12, fig. 3). Reexamination of Kensley's specimens (SAM 19479) has confirmed the conspecificity of his *N.* "*squamichelis*" with *N. crosnieri* n.sp. The new species is readily distinguished from both of Alcock's species. Alcock's *N. squamichelis* is described as having the squamiform, imbricating tubercles of the palms forming several series; the dorsomesial of the palm and dorsolateral margins of the palm and fixed finger are spinose. These margins are unarmed in *N. crosnieri*, and the squamae of the dorsal surfaces of the chelae do not form several distinct series. *Nematopagurus scutellichelis* was described and illustrated by Alcock (1905b: 112, pl. 12, fig. 5) as having almost nude chelipeds and ambulatory legs. The meri and carpi of the second and third pereopods were reportedly squamose, while the propodi were scutellated, the squamae and scutes being nude and polished. The carpi of both pairs were described with spinose dorsal margins. As may be seen in figure 1D, E, the ambulatory legs of *N. crosnieri* are abundantly setose on the dorsal and lateral surfaces of the propodi and carpi; the dorsal surfaces of the carpi do not have a row of spines.

Nematopagurus crosnieri bears a close resemblance to *N. scutelliformis* McLaughlin, 1997, not only in the form of the scutes of the chelae and carpi, and setation, but in the form of the telson. However, the chelae of *N. crosnieri* lack the spines on the dorsomesial margins of the palms and dorsolateral margins of the palms and fixed fingers that are present in *N. scutelliformis*.

Nematopagurus chauseyensis n.sp.
(Fig. 2)

MATERIAL EXAMINED. — **Madagascar.** *Vauban* stn CH 43, 15°24.5'S - 46°02'E, 250-265 m, 7.XI.1972, coll. A. Crosnier: 1 ♀ SL 4.3 mm (MNHN Pg 5540). — Stn CH 47, 15°20'S - 46°11.8'E, 245-250 m, 7.XI.1972: 2 ♂♂, 1 ovig. ♀ SL 3.5-5.0 mm (MNHN Pg 5541). — Stn CH 56, 23°36'S - 43°31.6'E, 395-410 m, 26.II.1973, coll. A. Crosnier: 1 ♀ SL 4.5 mm (MNHN Pg 5542), 1 ♂ SL 4.5 mm (MNHN Pg 5539), 1 ovig. ♀ SL 4.3 mm (USNM 276084), 1 ♀ SL 4.3 mm (SAM).

TYPE MATERIAL. — The female, SL 4.5 mm, from *Vauban* station CH 56 (MNHN Pg 5539) is the holotype. All other specimens mentioned here are paratypes.

DISTRIBUTION. — Madagascar; 245-410 m.

HABITAT. — Gastropod shells.

ETYMOLOGY. — This species is named for the French island of Chausey, home of Alain Crosnier, and official gathering place for "Crosnier's Cronies".

DESCRIPTION

Shield as broad or broader than long; anterolateral margins sloping; anterior margin between rostrum and lateral projections concave; posterior margin truncate; dorsal surface with several tufts of setae. Rostrum very broadly rounded, not produced to level of lateral projections. Lateral projections prominent, roundly triangular or subquadrate, each with laterally directed submarginal spine.

Ocular peduncles short, 0.75-0.80 length of shield; surfaces each with dorsomedian row of stiff setae at base of cornea, and sparse tufts of short setae dorsally and mesially; corneae strongly dilated, corneal diameter equal to or exceeding peduncular length. Ocular acicles small, triangular; terminating subacutely, with deeply concave dorsal surface and prominent submarginal spine.

Antennular peduncles moderately short, exceeding distal margin of corneae by 0.25-0.50 length of ultimate segment. Ultimate segment with longitudinal row of tufts of setae on dorsal surface. Penultimate segment with few scattered setae. Basal segment with numerous short setae dorsally and distally, prominent spine on lateral face.

Antennal peduncles moderately short, overreaching distal margin of cornea by 0.20-0.35 length of fifth segment. Fifth with few short setae dorsally and distally. Fourth segment with long stiff setae, especially on ventral surface. Third segment with small spine at ventrodistal angle completely concealed by long stiff setae. Second segment with dorsolateral distal angle produced, terminating in simple or bifid spine, lateral and mesial margins with long stiff setae; dorsomesial distal angle with small spine. First segment produced ventrolaterally as flattened subacute lobe. Antennal acicle moderately long, reaching to or beyond proximal half of ultimate peduncular segment; slightly arcuate, terminating in acute spine; mesial margin with numerous tufts of long stiff setae. Antennal flagella long, overreaching tip of right cheliped; occasionally few articles each with one or two very short setae or bristles, at least in proximal half.

Chelipeds subequal; right slightly stronger than left, but often somewhat shorter. Dactyl slightly shorter than palm; cutting edge with elongate fused pair of strong calcareous teeth separated from single similar calcareous tooth by two smaller calcareous teeth, few corneous teeth distally, terminating in small corneous claw and slightly overlapped by fixed finger; proximal half of dorsal surface with several low, short transverse scutes mesially and extending onto rounded, unarmed dorsomesial margin, each scute with marginal row of short stiff setae, tufts of somewhat longer setae distally and adjacent to cutting edge; mesial face and ventral surface with numerous short transverse ridges and longer setae. Palm 0.75-0.85 length of carpus; dorsomesial margin creased by series of short transverse scutes, each with small spine and fringe of stiff setae; dorsal surface with eleven to fifteen irregular transverse rows of short scutes continued onto lateral face, each with marginal row of short stiff setae; proximal 0.75-0.80 of dorsal surface of fixed finger with irregular transverse rows of short scutes provided with marginal short stiff setae, also continued onto lateral face as short transverse ridges with longer setae; distal 0.20-0.25 of dorsal surface nearly smooth, with only scattered tufts of setae; cutting edge with row of strong calcareous teeth, small calcareous teeth interspersed with corneous teeth distally, terminating in small corneous claw; ventral surfaces of palm and fixed finger with short transverse ridges and moderate to long setae. Carpus slightly shorter than merus; dorsodistal margin with row of short stiff setae; dorsomesial margin with row of moderately strong spines; dorsal surface with irregular transverse rows, each consisting of three to six short scutes, extending onto dorsal half of lateral face, and provided marginally with short stiff setae; dorsolateral margin not delimited; lateral, mesial and ventral surfaces with transverse ridges and moderate to long setae. Merus subtriangular; dorsal margin with row of transverse ridges and short to moderately long setae; lateral and mesial faces each with transverse ridges, longest in ventral third, and long stiff setae; ventrolateral margin with two to

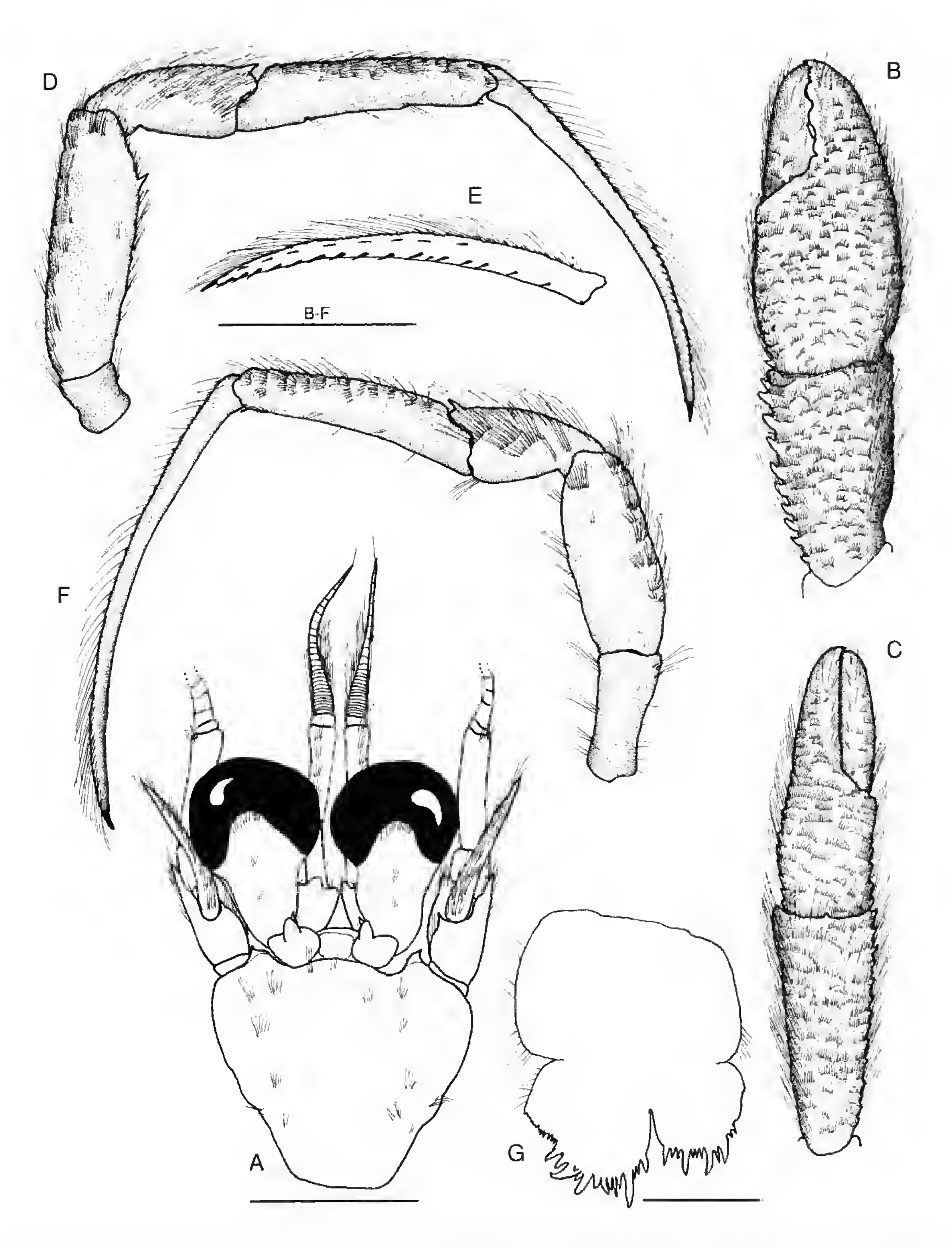


FIG. 2. — *Nematopagurus chauseyensis* n.sp., paratype, ♀ (SL 4.3 mm), *Vauban* stn CH 43 (MNHN Pg 5540); **A**, shield and cephalic appendages; **B**, carpus and chela of right cheliped (dorsal view); **C**, carpus and chela of left cheliped (dorsal view); **D**, right second pereopod (lateral view); **E**, dactyl of right second pereopod (mesial view); **F**, left third pereopod (lateral view); **G**, telson. Scale bars: A, 3 mm; B-F, 5 mm; G, 1 mm.

four acute spines in distal half; ventromesial margin with one to three spines; ventral surface with three or four transverse ridges, each with long stiff setae and occasionally one or two small spines. Ischium with few stiff setae; one spine at ventrolateral distal angle.

Left cheliped moderately slender. Dactyl slightly longer to nearly twice length of palm; cutting edge with row of small corneous teeth, terminating in small corneous claw and slightly overlapped by fixed finger; dorsal surface with row of sparse tufts of setae adjacent to cutting edge, few short marginally setiferous scutes proximally, extending onto mesial face dorsally; dorsomesial margin not delimited; mesial and ventral surfaces also with numerous long setae. Palm 0.65-0.75 length of carpus; dorsomesial margin not delimited, but with one or two spines proximally; dorsal surface, like that of right, with seven to eleven irregular transverse rows of short scutes, extending onto mesial and lateral faces and provided with marginal row of short stiff setae; dorsal surface of fixed finger with several transverse rows of short scutes in proximal 0.65-0.75, each with marginal fringe of short stiff setae, distal quarter to third nearly smooth, but with scattered tufts of setae; ventral surfaces all with short transverse rows of long stiff setae; cutting edge of fixed finger with row of small calcareous teeth interspersed with corneous teeth. Carpus approximately equal to slightly longer than merus; dorsodistal margin with row of short to moderately long stiff setae, dorsomesial margin with row of spines partially concealed by long stiff setae, dorsolateral margin not delimited; dorsal surface with irregular transverse rows of short, marginally setiferous scutes extending onto lateral face; mesial and ventral surfaces with tufts of stiff setae. Merus subtriangular; dorsal surface with transverse ridges and stiff setae, distal margin with row of moderately long stiff setae; lateral and mesial faces with tufts of stiff setae; ventral surface with low sometimes spinose ridges and long setae; ventromesial margin with one to three spines in distal 0.65, ventrolateral margin with two to four spines in distal half and few short sometimes spinulose ridges in proximal half. Ischium with spine at ventrolateral distal angle and scattered tufts of setae.

Ambulatory legs overreaching right cheliped by 0.10-0.25 length of dactyls. Dactyls very slender, 0.35-0.50 longer than propodi; in lateral view, curved ventrally; in dorsal view, strongly twisted in distal third to half; each terminating in small corneous claw; dorsal surfaces each with one or two rows of very short corneous spines and long stiff setae; mesial faces each with row of corneous spinules dorsally; lateral faces each with few scattered setae; ventral surfaces each with row of eleven to seventeen strong corneous spines increasing in size distally. Propodi 0.25-0.35 longer than carpi; dorsal surfaces each with row of short transverse scute-like ridges extending onto lateral faces and set with short to moderately long stiff setae; mesial and lateral faces with scattered setae; ventral surfaces usually with widely-spaced sparse tufts of setae, one or two corneous spines at ventrodistal angle. Carpi 0.50-0.85 length of meri; dorsal surfaces each with spine at dorsodistal angle and transverse rows of tufts of stiff setae; mesial and ventral surfaces each with few scattered tufts of long setae; lateral faces each with three to several short to moderately long transverse rows of stiff setae. Meri each with row of transverse ridges and stiff setae on dorsal surfaces; lateral and mesial faces usually with few tufts of setae; ventral surfaces with few tufts of setae, second also with one spine distally. Ischia each with setae dorsally and ventrally. Anterior lobe of sternite of third pereopods subsemicircular, with long stiff setae on anterior margin.

Males with well-developed, elongate, filiform sexual tube on coxa of right fifth pereopod, left one with very short sexual tube. Telson with posterior lobes slightly asymmetrical, subsemicircular to subrectangular; separated by deep median cleft; terminal margins rounded, each with row of long spines interspersed with smaller spines and extending onto lateral margins, sometimes with adjacent row of spinules on dorsal surface.

Colour

Not known.

Remarks

Nematopagurus chauseyensis bears a considerable resemblance to Alcock's (1905b) *N. squamichelis*

in having very short ocular peduncles with strongly dilated corneae, antennular and antennal peduncles that overreach the distal margins of the corneae, and the carpi and chelae of the chelipeds that are covered dorsally with transverse rows of setiferous short scutes. Alcock's specimen has not been available for reexamination; however, from his description and figure (Alcock 1905b: 113, pl. 12, fig. 1) *N. squamichelis* and *N. chauseyensis* are easily differentiated. Alcock's taxon is described as having spines on both the dorsomesial and dorsolateral margins of the palms of both chelipeds. *Nematopagurus chauseyensis* lacks spines on the poorly defined dorsolateral margin of the right chela, and has only one or two spines on the dorsomesial margin of the palm of the left cheliped. Additionally the ambulatory dactyls of *N. squamichelis* are described and illustrated as being stout and moderately long. The dactyls of *N. chauseyensis* are distinctly longer and much more slender.

Nematopagurus diadema Lewinsohn, 1969 (Fig. 3)

Nematopagurus diadema Lewinsohn, 1969: 74, fig. 13.

MATERIAL EXAMINED. — **South Africa.** North Zululand, Sodesana Bay, off Gobey's Point, *Meiring Naude* stn ZG 4, 27°26.2'S - 32°44.7'E, 120-150 m, 2.VI.1987: 1 ovig. ♀ SL 3.5 mm (PMcL).

DISTRIBUTION. — Red Sea; Mozambique Channel; 62-150 m.

HABITAT. — Lewinsohn (1969) reported the use of several species of gastropod shells.

DIAGNOSIS

Shield broader than long; surface with few very small tufts of setae. Rostrum rounded and nearly

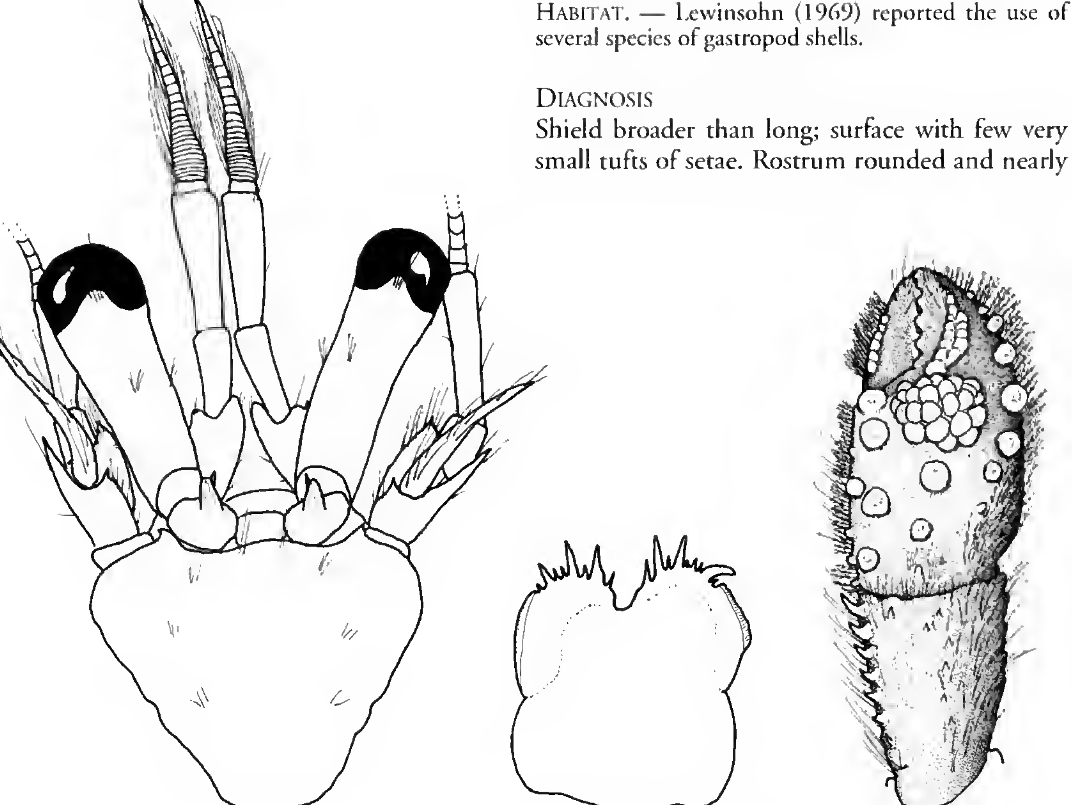


FIG. 3. — *Nematopagurus diadema* Lewinsohn, 1969, ovigerous ♀ (SL 3.5 mm), *Meiring Naude* stn ZG 4 (PMcL); **A**, shield and cephalic appendages; **B**, telson; **C**, carpus and chela of right cheliped (dorsal view). Scale bars: A, 1 mm; B, 2 mm; C, 0.5 mm.

obsolete. Lateral projections each with outwardly directed tiny spine. Ocular peduncles relatively long, approximately as long as shield; corneae slightly dilated. Ocular acicles relatively small, triangular, terminating subacutely, with submarginal spine. Antennular peduncles overreach distal margin of corneae by 0.25-0.33 length of ultimate segment. Antennal peduncles reaching beyond bases of corneae, but not to distal margins. Antennal acicle nearly reaching distal margin of ultimate peduncular segment.

Chelipeds similar, but right distinctly stronger. Right cheliped with row of rounded tubercles on dorsomesial surface of dactyl and adjacent row of tufts of plumose setae, neither extending to distal third; fixed finger with double row of similarly rounded tubercles in dorsal midline. Palm with elevated rosette (cluster) of rounded tuberculate platelets distally; dorsomesial margin with few small widely-spaced tubercles and adjacent irregular row of large almost pear-shaped tubercles, dorsal midline with two similar pear-shaped tubercles and one subacute small spine; dorsolateral margin of palm and fixed finger with row of widely-spaced similar tubercles and adjacent tufts of plumose setae. Carpus with row of acute spines on dorsomesial margin, few small spines on dorsal surface distally, and irregular row of small spines laterally. Ventrolateral margin of merus with one very prominent spine and few smaller spines proximally and on ventral surface; ventromesial margin with two small spines.

Left cheliped armed similarly to right, but dorsoproximal margin of palm with dense plumose setae not present on right.

Ambulatory legs similar. Dactyls 0.35-0.50 longer than propodi; dorsal margins each with row of long spiniform bristles; ventral margins each with eight to ten corneous spines. Propodi each with row of tufts of setae on dorsal margins. Carpi each with dorsodistal spine, second also with additional spine in proximal half. Meri with tufts of setae dorsally and ventrally.

Telson with subequal posterior lobes separated by moderately broad median cleft; terminal margins each with three or four strong spines interspersed with smaller spines; lateral margins each with weakly calcified marginal plate, more distinct on left.

COLOUR

In preservative only a faint hint of longitudinal stripes on the lateral surfaces of ambulatory legs remains.

REMARKS

The North Zululand specimen exhibits some differences from Lewinsohn's description of his Red Sea specimens. Specifically, the South African specimen has distinctly shorter ultimate segments in the antennular peduncles, shorter ambulatory dactyls, and an additional posterodorsal spine on the carpus of each second pereopod; however, these differences are well within the ranges of variation seen in species of *Nematopagurus*. The South African specimen shares the distinctive and unique armature of the chelae with Red Sea specimens of *N. diadema*, and there is no doubt that it is correctly assigned to this taxon. Witherington (1973) in an unpublished doctoral dissertation also reported a specimen of *N. diadema* from an *Anton Bruun* station in Mozambique Channel.

Nematopagurus holthuisi McLaughlin *et* Hogarth, 1998 (Fig. 4)

Nematopagurus holthuisi McLaughlin *et* Hogarth, 1998: 25, figs 19-26.

Nematopagurus muricatus – Laurie 1926: 161; not *Nematopagurus muricatus* (Henderson, 1896).

MATERIAL EXAMINED. — **South Africa.** North Zululand, SE Kosi River mouth, *Meiring Naude* stn ZA 29, 26°54.3'S - 32°54.8'E, 48 m, 8.VI.1987: 1 ovig. ♀ SL 2.8 mm (PMcL).

DISTRIBUTION. — Seychelles, North Zululand, South Africa; 45-48 m.

HABITAT. — Collected on muddy sand, *Halimeda* and seagrass beds in the Seychelles; habitat not reported for the North Zululand specimen.

DIAGNOSIS

Shield as broad or broader than long; dorsal surface with sparse tufts of setae anteriorly and laterally. Rostrum broadly rounded, weakly produced or nearly obsolete, not reaching level of lateral projections. Lateral projections roundly

triangular, each usually with prominent submarginal spine. Ocular peduncles 0.80-0.90 length of shield; dorsal surfaces each with median tuft of stiff setae at base of cornea, one additional tuft on mesial surface and short row on dorsal surface proximally; corneae somewhat dilated. Ocular acicles narrowly triangular; terminating acutely, with concave dorsal surface and prominent submarginal spine. Antennular peduncles overreaching distal margin of corneae by 0.20-0.50 length of ultimate segment. Antennal peduncles not overreaching distal margin of cornea. Second segment with dorsolateral distal angle produced, terminating in simple or bifid spine, lateral margin with one or two tufts of stiff setae, occasionally also with tiny spinule; dorsomesial distal angle with small spine. Antennal acicle reaching distal half of ultimate peduncular segment; arcuate, terminating in acute spine; mesial margin with few moderately long stiff setae. Antennal flagella slightly longer than outstretched right cheliped; every article with one or two very short setae.

Chelipeds subequal; right slightly longer and stronger. Dactyl somewhat shorter than palm; very slightly overlapped by fixed finger; dorsal surface unarmed or with few small spines, most numerous proximally, few tufts of setae distally, dorsomesial margin with row of stronger spines extending nearly to tip. Palm slightly shorter than carpus; dorsomesial margin with row of small spines; dorsal surface with scattered long setae and covered with extremely short fine setae and numerous but not densely packed, small spines, median longitudinal row of spines slightly stronger proximally; dorsolateral margin with

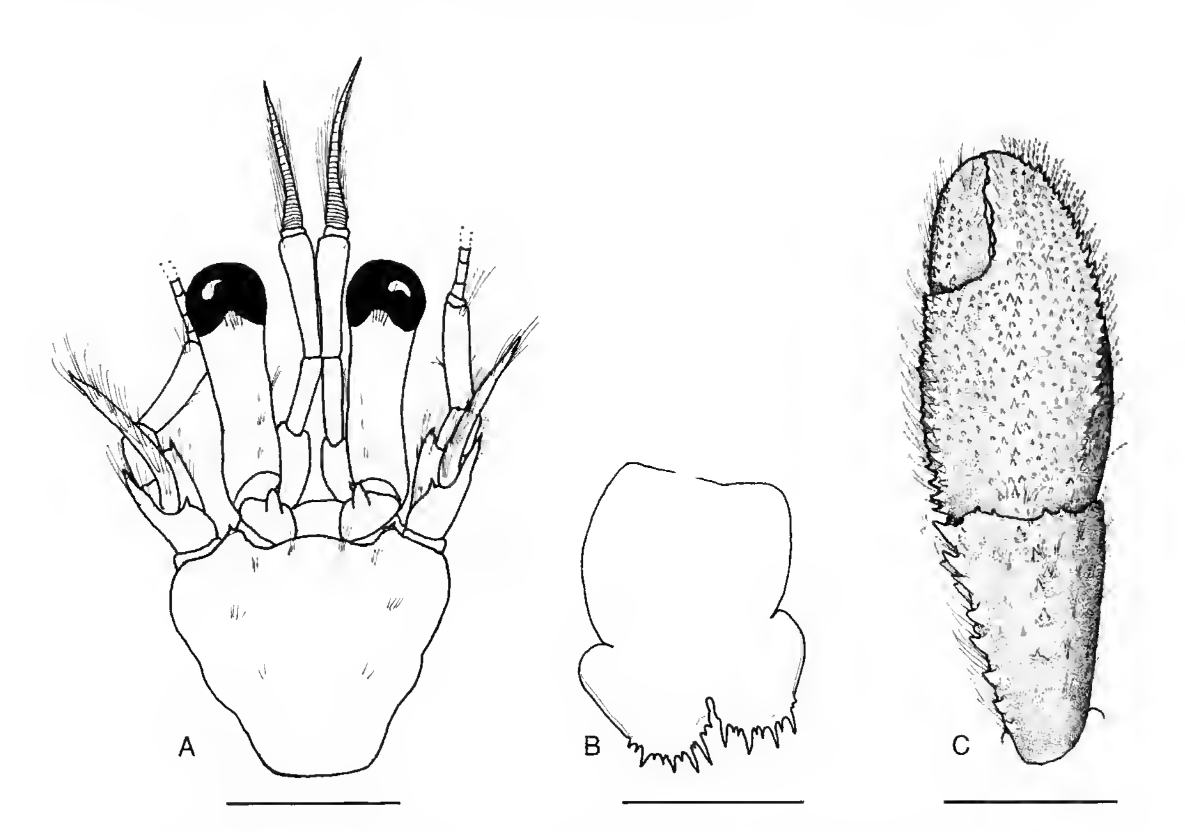


Fig. 4. — *Nematopagurus holthuisi* McLaughlin *et* Hogarth, 1998, ovigerous ♀ (SL 2.8 mm), *Meiring Naude* stn ZA 29 (PMcL); **A**, shield and cephalic appendages; **B**, telson; **C**, carpus and chela of right cheliped (dorsal view, fine setae of palm and fixed finger not shown). Scale bars: A, B, 2 mm; C, 1 mm.

row of spines extending to tip of fixed finger; dorsal surface of fixed finger with similar covering of small spines proximally and scattered longer setae distally. Carpus with one or two small spines on dorsodistal margin and sometimes one additional spine adjacent to margin, dorsomesial margin with row of spines; dorsal surface practically glabrous, dorsolateral margin with more irregular row of slightly smaller spines; mesial and ventral surfaces with tufts of long stiff, iridescent setae. Merus with two strong spines on ventrolateral margin distally; ventromesial margin with one to three spines in distal half; ventral surface with two transverse rows of two or three acute, subacute or blunt spines and tufts of long stiff iridescent setae.

Left cheliped reaching beyond base of dactyl of right; moderately slender. Dactyl slightly longer than palm; slightly overlapped by fixed finger; dorsal surface unarmed or with few small spines in proximal half, dorsomesial margin with row of spines extending nearly to tip, surfaces all with stiff setae. Palm approximately 0.50 length of carpus; dorsomesial margin with row of small spines; dorsal surface covered with extremely short fine setae and numerous, but not densely packed, small spines, median longitudinal row on slightly raised midline more distinct proximally; dorsolateral margin with row of spines, extending nearly to tip of fixed finger; surfaces with long stiff setae. Carpus with spine dorsodistal margin; dorsomesial and dorsolateral margins each with row of spines. Merus with one or two spine on ventrolateral margin and sometimes small spine at ventrolateral distal angle; ventromesial margin with two strong spines in distal half; ventral surface with transverse row of few small spines or tubercles distally, transverse unarmed or spinulose ridge proximally.

Ambulatory legs all of approximately equal length. Dactyls of second pair approximately 1.10 length of propodi, dactyls of third pair about 1.25 length of propodi; dorsal surfaces each with row of corneous spines and few moderately long setae; mesial faces each with row of short corneous spines dorsally; ventral margins each with row of eight to ten (second), and eleven or twelve (third) corneous spines. Propodi each with low protuberances and tufts of short setae on dorsal surfaces; one small corneous spine at each ventrodistal angle, and one additional corneous spine near mid-length. Carpi all with small spine at dorsodistal angle; second pair each with one or two additional small spines on dorsal surface in proximal half. Meri with widely-spaced tufts of setae dorsally; ventral margins each with low protuberances (sometimes spinose on second) and tufts of stiff setae. Anterior lobe of sternite of third pereopods subquadrate, with few marginal setae.

Coxa of fifth right pereopod with long sexual tube directed across ventral thorax and coiled in distal half; left tube short, directed somewhat posteriorly. Telson with posterior lobes practically symmetrical; separated by moderately deep median cleft; terminal margins somewhat rounded, left with four or five moderately large spines, right with four; lateral margins each with distinct chitinous plate, left sometimes with one to three tiny spinules.

Colour

In preservative: ocular peduncles each with band of color near proximal margin ultimate segment. One distal or subdistal and one median circular band of color on both dactyl and fixed finger of each cheliped. Ambulatory legs longitudinally striped as follows: ischia each with three stripes on lateral face; meri, carpi and propodi each with one dorsal, one ventral, and three lateral stripes, with the upper and lower lateral stripes interrupted medially on the meri and propodi. Dactyls of the ambulatory legs with faint uniform coloration and darker subdistal band (after McLaughlin & Hogarth 1998).

Remarks

McLaughlin & Hogarth (1998) described *N. holthuisi* from specimens collected during the Netherlands Seychelles Expedition of 1992-1993, and indicated that this was the same species reported from the Seychelles by Laurie (1926) as *N. muricatus* (Henderson, 1896). As noted by McLaughlin & Hogarth (1998), *N. holthuisi* is even more similar to *N. lewinsohni* Türkay, 1986 in the general armature of the chelae, but *N. holthuisi* is readily distinguished by its: (1) longer, more slender ocular peduncles

with only slightly dilated corneae; (2) longer antennular peduncles; (3) ambulatory legs that are all of relatively equal total length; and (4) carpi of second pereopods that have one or two proximal spines in addition to the dorsodistal spine. The single specimen of *N. holthuisi* collected during the *Meiring Naude* cruise agrees quite well with the Seychelles specimens, although the spines of the chelipeds are a little smaller, and the meri each have an additional spine on the ventromesial margin. This is the first record of this species in South African waters.

Nematopagurus kosiensis n.sp.
(Fig. 5)

MATERIAL EXAMINED. — **South Africa.** North Zululand, Sodesana Bay, Off Gobey's Point, *Meiring Naude* stn ZG 4, 27°26.2'S - 32°44.7'E, 120-150 m, 2.VI.1987: 1 ovig. ♀ SL 3.5 mm (MNHN Pg 5543).

TYPE MATERIAL. — The single ovigerous female from off Gobey's Point, Sodesana Bay, North Zululand, South Africa is the holotype.

DISTRIBUTION. — Known only from type locality off North Zululand, South Africa; 120-150 m.

HABITAT. — Collected from sandstone rubble with glass sponges.

ETYMOLOGY. — This species is named for the region of the type locality, SE of the mouth of the Kosi River, Zululand, South Africa.

DESCRIPTION

Shield longer than broad; anterolateral margins sloping; anterior margin between rostrum and lateral projections somewhat concave; posterior margin truncate; dorsal surface with sparse tufts of setae generally circumscribing gastric region. Rostrum very obtusely and roundly triangular, reaching level of right lateral projection, slightly overreaching left. Lateral projections prominent, obtusely triangular, right with small submarginal spine, left unarmed.

Ocular peduncles approximately 0.80 length of shield; dorsal surfaces each with sparse median tuft of stiff setae at base of cornea, two very sparse tufts on dorsal surface and additional tuft mesially; corneae not noticeably dilated, width about 0.35 peduncular length. Ocular acicles small, triangular; terminating acutely, with concave dorsal surface and prominent submarginal spine.

Antennular peduncles overreaching distal margin of corneae by nearly 0.80 length of ultimate segment. Ultimate segment with one or two fine setae. Basal segment with prominent spine on dorsolateral margin.

Antennal peduncles overreaching distal margin of cornea by approximately 0.20 length of fifth segment. Fifth and fourth segments with few setae. Third segment with sparse tuft of stiff setae at ventrodistal angle. Second segment with dorsolateral distal angle produced, terminating in strong spine, lateral margin with few setae; dorsomesial distal angle with small spine. First segment with one spinule on ventrolateral margin distally. Antennal acicle long, overreaching distal margin of cornea and reaching distal half of ultimate peduncular segment; arcuate, terminating in acute spine; mesial margin with few moderately long stiff setae. Antennal flagella missing.

Chelipeds subequal; right slightly longer and stronger. Dactyl slightly shorter than palm; cutting edge with two proximal and one median strong calcareous teeth separated by row of small calcareous denticles, row of corneous teeth distally, terminating in small corneous claw and very slightly overlapped by fixed finger; convex dorsal surface and dorsomesial margin with scattered sparse tufts of moderately long setae; mesial and ventral surfaces with scattered long setae. Palm slightly shorter than carpus; dorsomesial margin with row of small spines; dorsal midline with longitudinal row of spines in proximal third, dorsal surface with few very sparse tufts of setae; dorsolateral margin with row of tiny spinules extending approximately half length of fixed finger; dorsal surface of fixed finger with scattered, moderately long setae; cutting edge with three moderately small calcareous teeth proximally, one large calcareous tooth medially and row of quite small calcareous teeth distally, terminating in small corneous claw; lateral and ventral surfaces of palm and fixed finger with scattered setae. Carpus slightly longer than merus; dorsodistal margin with one prominent spine, dorsomesial and dorsolateral margins each with row of slender acute spines and long, moderately stiff

setae; dorsal surface with few scattered long setae; lateral, mesial and ventral surfaces all with sparse tufts of long setae, ventrolateral distal angle with spinule. Merus subtriangular; dorsodistal margin with row of moderately stiff long setae; dorsal margin, mesial, lateral and ventral faces all with short transverse rows of long setae; ventrolateral margin with two widely-spaced acute spines distally, spinule and spinulose protuberances proximally; ventromesial margin with one strong spine at distal angle and one marginal smaller spine in distal half. Ischium with few setae dorsally and ventrally; ventrolateral distal angle with acute spine.

Left cheliped long, reaching almost to tip of dactyl of right; moderately slender. Dactyl approximately 0.25 longer than palm; cutting edge with row of small corneous teeth, terminating in small corneous claw and very slightly overlapped by fixed finger; rounded dorsal surface with two rows of widely-spaced sparse tufts of long setae; mesial and ventral surfaces with few moderately long setae. Palm approximately 0.65 length of carpus; dorsomesial margin with row of quite small spines; dorsal surface with short longitudinal row of small spines in slightly elevated midline, not extending onto fixed finger; dorsal surface laterad of midline microscopically rugose, dorsolateral margin with row of very small spinules, extending nearly to distal half of fixed finger; all surfaces with scattered long setae; cutting edge of fixed finger with row of small calcareous teeth. Carpus slightly longer than merus; dorsodistal margin with one acute spine; dorsomesial and dorsolateral margins each with row of spines strongest mesially; mesial, lateral and ventral surfaces all with short transverse rows of long stiff setae; ventrolateral distal angle with minute tubercle. Merus subtriangular; dorsodistal margin with row of stiff setae, dorsal surface with transverse rows of setae; ventromesial margin with three small spines in distal half, transverse ridges and setae proximally; ventrolateral margin with three stronger spines in distal half, spinulose protuberances proximally. Ischium with row of widely-spaced spinules and setae on ventromesial margin; ventrolateral distal angle with small spine.

Ambulatory legs elongate, overreaching tips of chelipeds by nearly half lengths of dactyls. Dactyls 1.10-1.20 length of propodi; dorsal surfaces each with few short setae and row of corneous bristles; mesial faces each with row of small corneous spines dorsally; lateral faces with few scattered setae; ventral margins each with row of ten to thirteen corneous spines. Propodi 1.35-1.40 longer than carpi; dorsal surfaces each with row of widely-spaced low protuberances and sparse tufts of setae; row of widely-spaced small corneous spinules on ventral surfaces. Carpi 0.65-0.75 length of meri; dorsal surfaces each with dorsodistal and dorsoproximal spine and row of tufts of sparse setae; ventral and lateral surfaces with few setae. Meri with few setae dorsally and ventrally, ventral margins of second pair each with acute spine at lateral distal angle and one additional spine in distal half. Ischia unarmed. Anterior lobe of sternite of third pereopods subquadrate, with few marginal setae.

Male not known. Telson with median indentation indicating anterior and posterior lobes; anterior lobes distinctly narrower than posterior lobes; latter practically symmetrical, separated by distinct median cleft; terminal margins roundly oblique, each with row of moderately strong calcareous spines interspersed with smaller spines; lateral margins each with spinose weakly calcified plate.

Colour

In preservative: most colour has faded, but a pair of longitudinal stripes is still apparent on the lateral faces of meri and carpi of chelipeds and on meri, carpi and propodi of second and third pereopods.

Remarks

In the armature of the chelipeds, this species most closely resembles *N. longicornis* from the Atlantic. However, the shorter ocular peduncles with strongly dilated corneae, and the single dorsodistal spine on each carpus of the second pereopods immediately distinguishes *N. longicornis* from the South African species. There is also a superficial similarity between *N. kosiensis* and *N. alcocki* McLaughlin, 1997 described from Indonesia. The armature of the chelipeds and ambulatory legs is very similar in the two species,

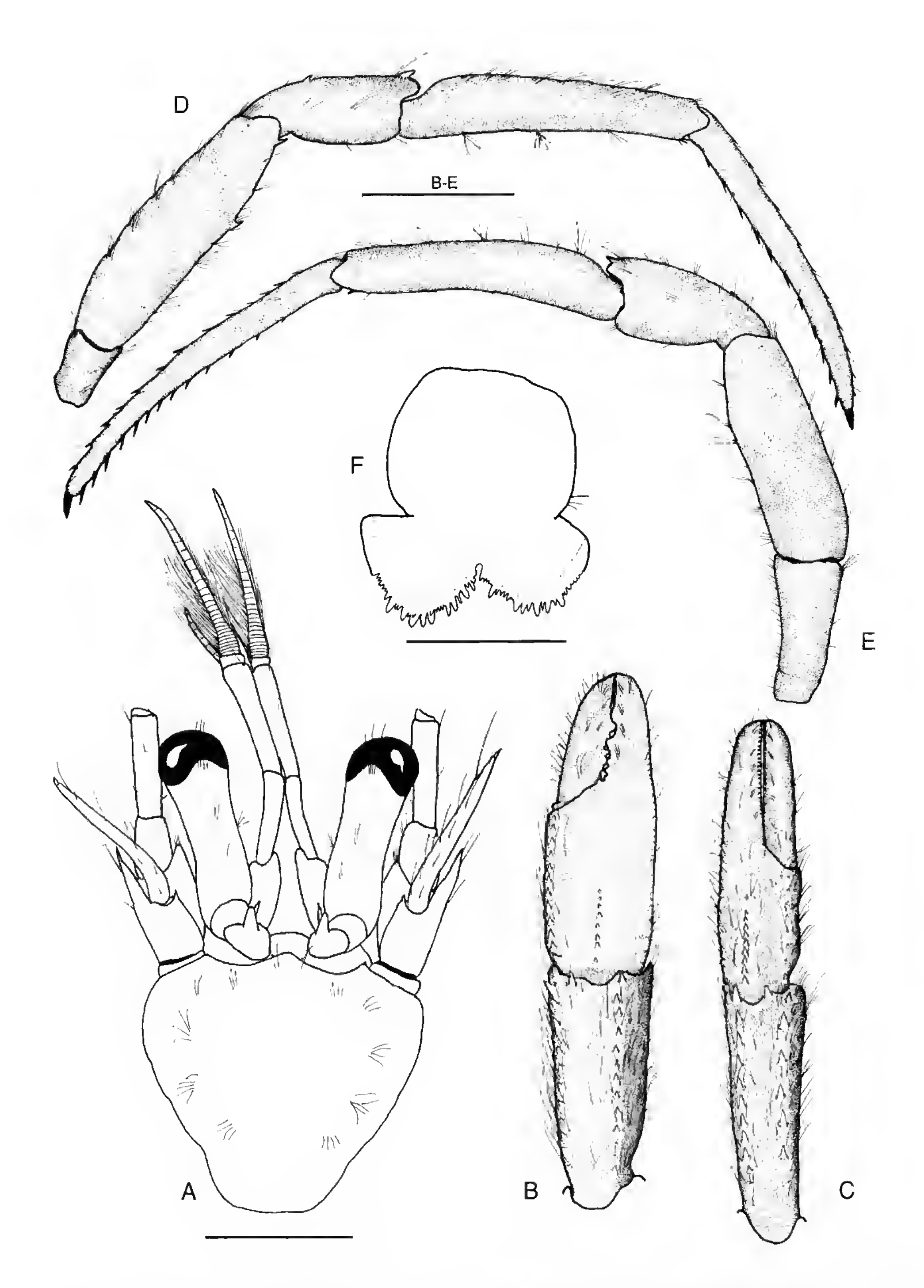


FIG. 5. — *Nematopagurus kosiensis* n.sp., holotype ovigerous ♀ (SL 3.5 mm), *Meiring Naude* stn ZG 4 (MNHN Pg 5543); **A**, shield and cephalic appendages; **B**, carpus and chela of right cheliped (dorsal view); **C**, carpus and chela of left cheliped (dorsal view); **D**, right second pereopod (lateral view); **E**, left third pereopod (lateral view); **F**, telson. Scale bars: A, 2 mm; B-E, 3 mm; F, 1 mm.

but the dorsal surfaces of the palms and fixed fingers of *N. alcocki* have an abundance of short setae that is lacking on those surfaces in *N. kosiensis*. As in *N. longicornis*, the ocular peduncles of *N. alcocki* are short, stout and the corneae distinctly dilated. Additionally, the anterior lobe of the sternite of the third pereopods in *N. alcocki* is roundly subrectangular, but subquadrate in *N. kosiensis*; the telson of *N. alcocki* has four or five large spines and only one or two spinules extending onto the lateral margin, whereas the terminal margins of the telson of *N. kosiensis* have numerous large and smaller spines and the plate of the lateral margin is spinose over the entire length.

Nematopagurus meiringae n.sp.
(Fig. 6)

Nematopagurus gardineri – Kensley 1969: 163, figs 6e-h; not *Nematopagurus gardineri* Alcock, 1905a.

MATERIAL EXAMINED. — **South Africa.** Transkei, off Mgazi, *Meiring Naude* stn J3, 31°46.3'S - 29°30.9'E, 96 m, 15.VIII.1982: 1 ♂ SL 2.8 mm (MNHN Pg 5544). — Off Durban, Natal, *Anton Bruun* stn 390, 29°35'S - 31°42'E, 138 m, 9.IX.1964: 1 ♂ SL 2.4 mm (SAM A19478).

TYPE MATERIAL. — The male with a shield length of 2.8 mm from off Mgazi, South Africa (MNHN Pg 5544) is the holotype. The male from off Durban (SAM A19478) is the paratype.

DISTRIBUTION. — Southeastern South Africa, off Transkei and Natal; 96-138 m.

HABITAT. — Sand and rubble substrate.

ETYMOLOGY. — Named for the research vessel *Meiring Naude*.

DESCRIPTION

Shield generally smooth, with few tufts of setae laterally; very slightly broader than long; anterior margin between nearly obsolete rostral lobe and lateral projections weakly concave; anterolateral margins terraced; posterior margin roundly truncate. Lateral projections produced, each with small marginal spine.

Ocular peduncles moderately long, 0.60-0.80 length of shield; one or two stiff setae on mesial surface and one or two tufts of thinner setae on dorsal surface; corneae dilated, maximal corneal width included 1.5-2.0 times in peduncular length; ocular acicles triangular, terminally subacute, with small submarginal spine.

Antennular peduncles overreaching distal margins of corneae by 0.25-0.35 length of ultimate segment. Ultimate segment with one or two dorsodistal setae and one or two widely-spaced tufts on dorsal surface. Basal segment with small spine on lateral face.

Antennal peduncles reaching to or nearly distal margins of corneae. Fifth and fourth segments with few moderately stiff setae. Third segment with small spine at ventrodistal angle, partially obscured by long stiff setae. Second segment with dorsolateral distal angle produced to approximately mid-length of fourth segment, with terminal spine and few stiff setae; dorsomesial distal angle with small spine. First segment with distolateral margin unarmed, ventrolateral margin with one to three small spines distally. Antennal acicle reaching to distal half of fifth peduncular segment, arcuate, terminating in strong spine, and with sparse tufts of long setae on mesial face. Antennal flagellum long, with one or two short setae every two to six articles, at least proximally.

Chelipeds generally similar; right cheliped slightly stouter and distinctly longer than left. Dactyl 0.75-0.80 length of palm; dorsomesial margin with three or four small spines proximally; dorsal and mesial surfaces with numerous long setae providing very setose marginal appearance; dorsal midline with row of moderately small spines, not reaching to tip; cutting edge with several calcareous teeth in proximal 0.75, corneous teeth distally, terminating in corneous claw and slightly overlapped by fixed finger. Palm slightly shorter than carpus; dorsomesial margin with irregular row of strong spines, dorsal midline slightly elevated and armed with row of similarly-sized spines extending onto fixed finger proximally; dorsolateral margin also with row of moderately strong spines, decreasing in size proximally on palm and distally on fixed finger, but not extending to tip; dorsal surface otherwise unarmed (holotype) or with cluster of four small spines distomesially; dorsal surface of palm distally and fixed finger proximally with long, moderately

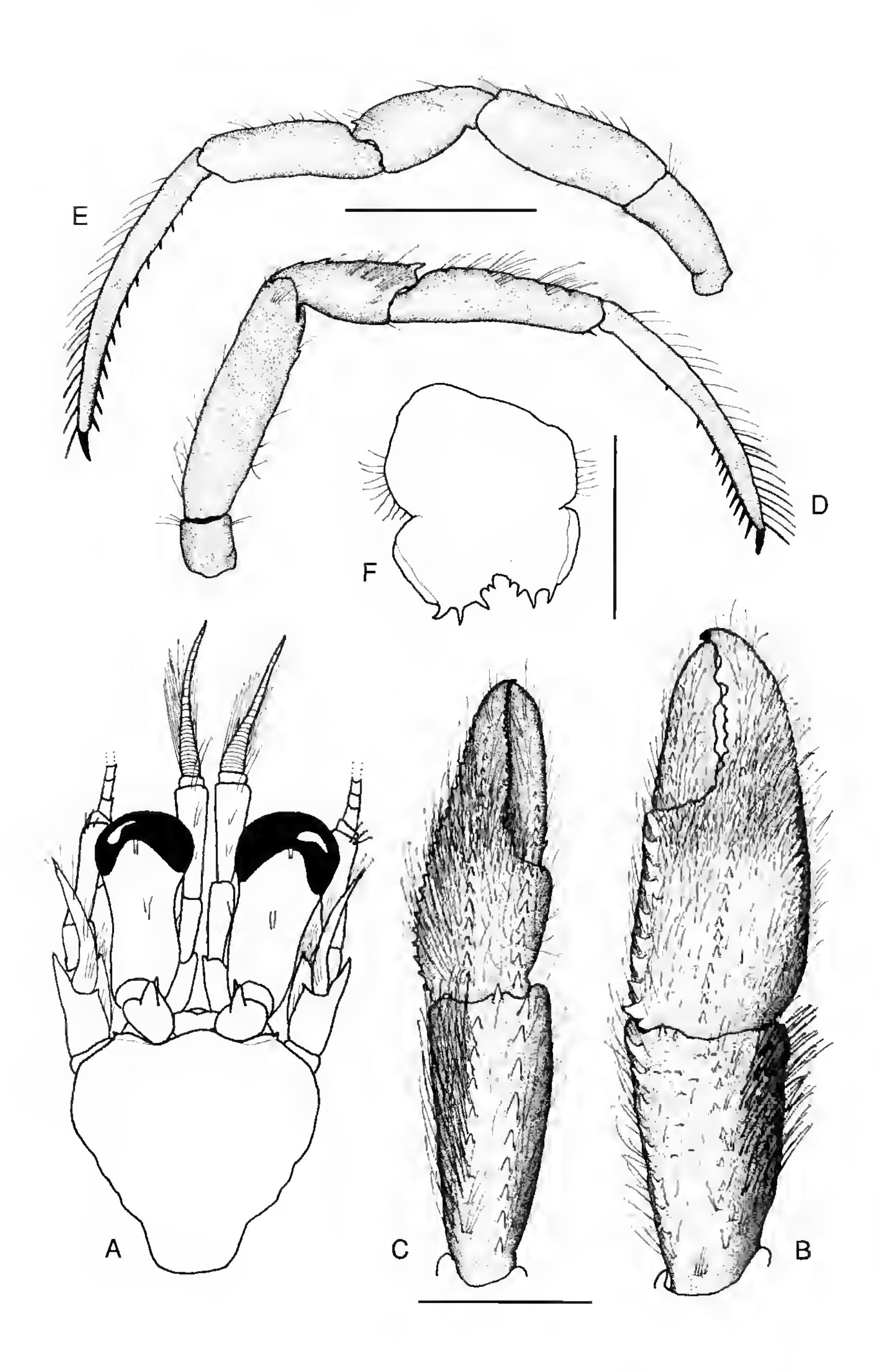


Fig. 6. — *Nematopagurus meiringae* n.sp., holotype ♂ (SL 2.8 mm), *Meiring Naude* stn J3 (MNHN Pg 5544); **A**, shield and cephalic appendages; **B**, carpus and chela of right cheliped (dorsal view); **C**, carpus and chela of left cheliped (dorsal view); **D**, right second pereopod (lateral view); **E**, left third pereopod (lateral view); **F**, telson. Scale bars: A-C, 2 mm; D, E, 3 mm; F, 1 mm.

dense setae, remainder of dorsal surface of palm and fixed finger with sparser covering of moderately short to moderately long setae, partially concealing armature; mesial and lateral faces with transverse ridges and long setae; ventral surfaces of palm, fixed finger and dactyl all with scattered long setae. Carpus slightly longer than merus; dorsomesial margin with row of strong spines and long stiff setae, dorsal surface with few low protuberances, dorsodistal margin with prominent spine and one much smaller spine; dorsolateral margin not distinctly delimited, but with row of much smaller spines and transverse rows of long, very stiff, iridescent setae extending onto lateral face; mesial face also with transverse rows of long setae; ventrolateral distal angle with adjacent small spine. Merus with short transverse rows of stiff setae; ventromesial margin with row of three moderately widely-spaced spines in proximal 0.65; dorsolateral margin with one or two prominent and one or two smaller spines in proximal 0.75; ventral surface with transverse rows of setae. Ischium with few tufts of setae dorsally and ventrally.

Left cheliped with dactyl 0.10-0.30 longer than palm; dorsomesial margin with long setae partially concealing strong spine near proximal angle; dorsal surface with short proximal row of four or five small spines in midline and numerous long setae; mesial face with short perpendicular rows of long setae dorsally and ventrally. Palm approximately 0.50-0.55 length of carpus; dorsomesial margin with long setae not concealing row of moderately strong spines; dorsolateral margin with dense long setae at least partially concealing row of spines decreasing in size on fixed finger but not extending to tip; dorsolateral surface unarmed, but with covering of long moderately dense setae, dorsal midline with row of spines becoming considerably smaller on fixed finger and not extending to tip; dorsomesial surface of palm unarmed, but with sparser covering of long setae. Carpus with row of strong spines and long setae on dorsomesial margin; dorsolateral margin also with long setae par-

TABLE 1. — Characters distinguishing *N. gardineri* Alcock, 1905 from *N. meiringae* n.sp.

Character	*N. gardineri* Alcock, 1905	*N. meiringae* n.sp.
Ocular peduncles	Nearly equal to length of shield	Approximately 0.80 of shield length
Corneal diameter	Included approximately 3 times in peduncle length	Included 1.5-2 times in peduncle length
Right cheliped: dactyl	Row of spines on dorsomesial margin; dorsal surface with few tufts of setae spines	3-4 proximal spines on dorsomesial margin; dorsal surface with median row of spines
Right cheliped: palm	Dense long setae proximally on dorsal surface; dorsal surface mesially and laterally each with 2 rows of small spines	Dense long setae distally on dorsal surface; dorsal surface mesially and laterally unarmed or cluster of few spines mesially
Right cheliped: carpus	Dorsal surface with iridescent sheen	Dorsal surface without iridescent sheen
Left cheliped: dactyl	Row of spines on dorsomesial margin; dorsal surface with few tufts of setae	1 spine on dorsomesial margin proximally; dorsal midline with row of 4 or 5 spines
Left cheliped: palm	Dense long setae on dorsal surface proximally; dorsomesial and dorsolateral surfaces each with several small spines	Dense long setae on lateral surface extending onto fixed finger; dorsomesial and dorsolateral surfaces unarmed
Telson	Terminal margins each with several strong spines interspersed with smaller spines and extending onto lateral margins	Terminal margins each with 1 or 2 small spines near midline, 3 large spines laterally, and not extending onto lateral margins

tially concealing short row of smaller spines; dorsodistal margin with one small spine; mesial and lateral faces with low protuberances and tufts of setae, ventrolateral margin with spinule at angle. Merus with few long setae dorsally; ventromesial margin with row of three widely-spaced spines in proximal 0.75; ventrolateral margin with three spines in distal half; ventral surface with few long setae. Ischium with sparse tufts of setae dorsally and ventrally.

Ambulatory legs with dactyls 1.40-1.60 longer than propodi; dorsal margins each with row of long corneous bristles in distal half and moderately long stiff setae proximally; ventral margins each with eight to thirteen corneous spines. Propodi of right longer than left; dorsal surfaces each with low protuberances and short to moderately long stiff setae; ventral surfaces each with corneous spine at distal margin and one additional corneous spine in distal half (paratype only), tufts of stiff setae proximally. Carpi each with dorsodistal spine, on second pereopod separated by low protuberances and tufts of stiff setae from two small spines in proximal half. Meri each with low protuberances and tufts of stiff setae dorsally and ventrally; second often also with small spine on ventral margin in distal 0.25. Fourth pereopods missing in both holotype and paratype. Sternite of third pereopods subsemicircular, and slightly skewed to left, with marginal long setae.

Well developed right sexual tube forming one or two loops. Telson with transverse indentation suggesting separation into anterior and posterior portions; asymmetrical posterior lobes separated by shallow median cleft, terminal margins each with three strong spines and one or two smaller spines; lateral margins each with distinct chitinous plate.

COLOUR

Not known.

REMARKS

Alcock's (1905a, b) description of *N. gardineri* was based on a specimen collected by E. Stanley Gardiner, whose materials have, for the most part, been deposited in the collections of the University Museum of Zoology, Cambridge, U. K. Having now examined Alcock's type specimen, an ovigerous female (SL 2.1 mm), it is not difficult to understand why Kensley (1969) thought he was reporting Alcock's taxon. With the exception of the shorter and more broadly dilated corneae, *N. meiringae* n.sp. is superficially quite similar to Alcock's (1905a: pl. 68, fig. 3; 1905b: pl. 12, fig. 2) illustrations. However, as may be seen from table 1, when the two species are critically evaluated, there is no doubt of their distinctiveness. Whether other reports of *N. gardineri* (*i.e.* Miyake 1978; Haig & Ball 1988) actually represent Alcock's (1905a, b) taxon, *N. meiringae*, or other, possibly undescribed species of the genus, remain to be determined.

Nematopagurus spinulosensoris McLaughlin *et* Brock, 1974 (Fig. 7)

Nematopagurus spinulosensoris McLaughlin *et* Brock, 1974: 246, figs 1-3. – McLaughlin & Lane 1975: 520, pls 1-3. – McLaughlin 1997: 510, figs 20d, 41a, b.

Nematopagurus spinulosensorius – Türkay 1986: 139 (misspelling).

Nematopagurus muricatus – Thompson 1943: 424. – Miyake 1978: 129; not *Nematopagurus muricatus* (Henderson, 1896).

? *Nematopagurus* sp. – Kensley 1978: 258, fig. 4.

MATERIAL EXAMINED. — **South Africa.** Th. Mortensen's Java-South Africa Expedition, stn 24, off Durban: 1 ♀ SL 6.9 mm (ZMUC CRU 2663). — Off Natal, *Meiring Naude* stn A-14, 31°08.9'S - 30°15.7'E, 111 m, VIII.1981: 1 ♂ SL 8.7 mm (PMcL). — Stn X3, 30°22.6'S - 30°50.8'E, 124 m, 19.VIII.1981: 1 ♀ SL 4.4 mm (PMcL). — Stn X6, 30°23.2'S - 30°50.8'E, 140 m, 19.VIII.1981: 1 ♂ SL 6.5 mm (PMcL).

DISTRIBUTION. — Hawaiian Islands; Japan; Maldive Islands, Indonesia; east coast of South Africa; 111-250 m.

HABITAT. — Sand and sponge rubble.

DIAGNOSIS. — Shield longer than broad. Rostrum usually obtusely rounded, occasionally obtusely triangular. Ocular peduncles overreached by both antennular and antennal peduncles; corneae usually strongly dilated.

Ocular acicles acutely triangular, moderately slender, with prominent longitudinal furrow and very strong submarginal spine.

Chelipeds subequal, right usually somewhat larger; chelae and carpi of both chelipeds with numerous sensory-modified spines on dorsal surfaces. Right cheliped with dorsal surface of dactyl generally flattened, dorsomesial margin, or dorsal surface mesially, usually with irregular longitudinal row of unmodified small spines or tubercles. Palm with irregular single or double row of modified or unmodified moderately strong spines on dorsomesial margin; dorsal surface with several irregular rows of customarily modified spines, extending onto fixed finger proximally; dorsolateral margin with single or double row of moderately strong, usually modified spines, extending onto fixed finger as single row of blunt modified or unmodified spines or tubercles. Carpus with row of strong unmodified spines on dorsomesial margin; dorsal surface with very irregular rows of moderately strong, generally modified spines; laterodistal margin with acute spine. Distal margin of merus usually with one to three strong acute spines; ventrolateral margin with row of few to several strong spines; mesiodistal margin and ventromesial face distally usually with few small spines.

Left cheliped with short row of small unmodified spines or spinulose tubercles usually in dorsal midline of dactyl. Palm with single or double row of frequently modified spines on dorsome-

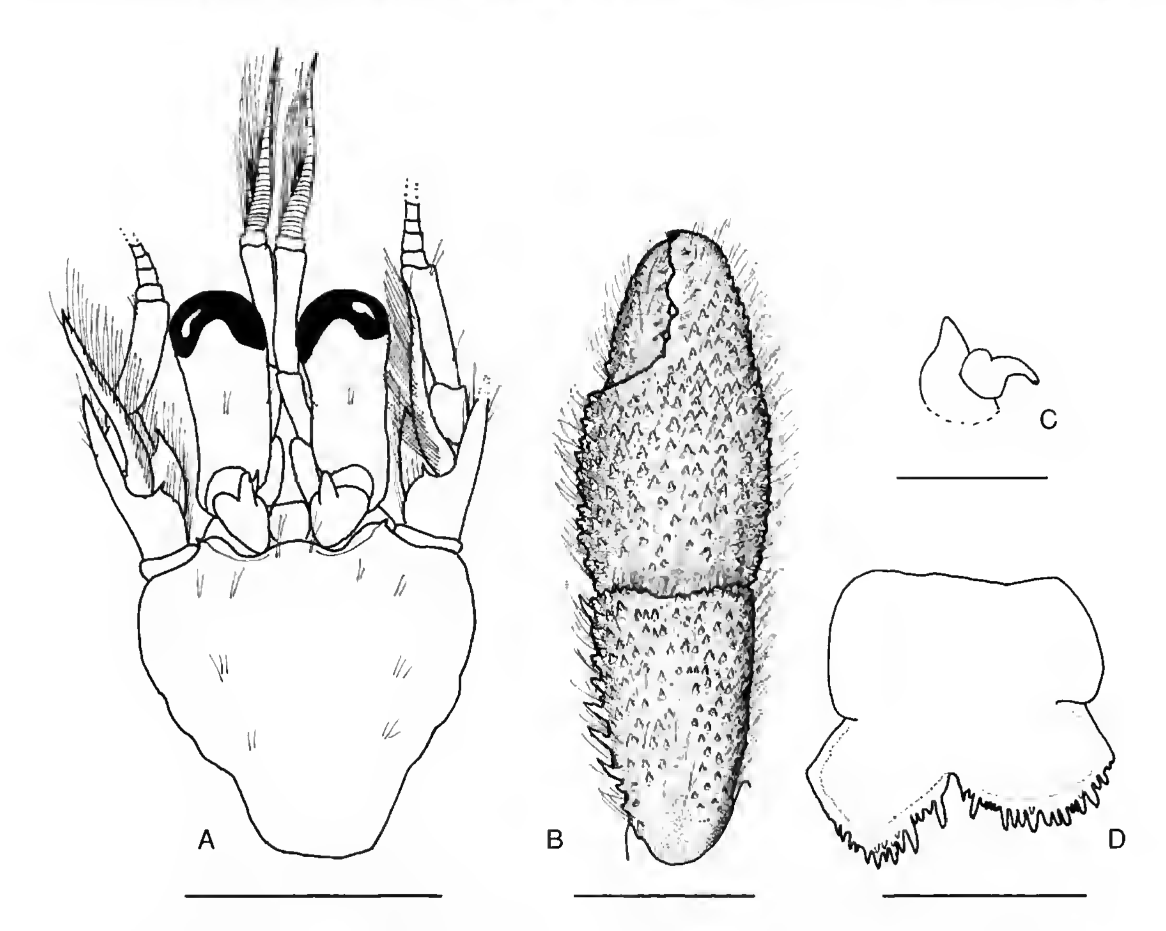


FIG. 7. — *Nematopagurus spinulosensoris* McLaughlin *et* Brock, 1974, ♂ (SL 6.5 mm), *Meiring Naude* stn X6 (PMcL); **A**, shield and cephalic appendages; **B**, carpus and chela of right cheliped (dorsal view); **C**, enlargement of single sensory-modified spine; **D**, telson. Scale bars: A, B, 5 mm; D, 2 mm; C, 0.5 mm.

sial margin; dorsal midline with two or three irregular rows of usually modified spines extending onto fixed finger; dorsolateral margin wirh double or triple row of small modified spines proximally becoming single row of small unmodified spines or tubercles on fixed finger. Carpus wirh row of frequenrly unmodified spines on dorsomesial margin; dorsal surface with two or three irregular rows of modified spines proximally, tending to cluster distally, distal margin occasionally with one or two spines; dorsolateral margin wirh single or double row of commonly modified spines. Merus with one ro three spines on distal margin; ventromesial and ventrolateral margins each with one row of spines.

Second and rhird pereopods generally similar. Dactyls long, slender; ventral surfaces each with one row of ten to fifteen strong corneous spines. Carpi each with one row of strong spines on dorsal surfaces. Sternite of third pereopods with subsemicircular anterior lobe, anterior margin with long stiff setae.

Coxa of lefr fifth pereopod with vas deferens usually slightly protruded. Telson with posterior lobes subtriangular or subquadrate, left usually slightly larger; separated by very shallow median clefr; terminal and usually also lateral margins weakly calcified, terminal margins rounded or somewhat oblique, each with numerous small calcareous spines marginally and several stronger calcareous acute or blunt spines submarginally; lateral margins unarmed or occasionally each with one row of small calcareous spines or spinules.

Colour

In life: chelipeds and ambulatory legs generally vivid salmon-pink, bordering on iridescent; antennal flagella bright yellow.

In preservative: shield pale orange or srraw-colored; ocular peduncles light orange with dark orange ring proximally. Chelipeds very pale orange with white spines; carpi with darker red-orange proximally and ventrally. Ambulatory legs pale orange with lighter longitudinal stripes on dactyls and propodi; carpi pale orange with darker red-orange proximally; meri pale orange and white (McLaughlin & Brock 1974).

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A new genus and species of dromiid crab (Brachyura, Dromiidae) from the Timor Sea, North-West Australia with records of other species from the China Sea

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MacLay C. L. 1998. — A new genus and species of dromiid crab (Brachyura, Dromiidae) from the Timor Sea, Northwest Australia with records of other species from the China Sea. *Zoosystema* 20 (2) : 339-350.

ABSTRACT

A new genus and species of dromiid crab, *Alainodromia timorensis*, is described from the Holothuria Bank, Timor Sea, based on specimens collected by HMS *Penguin* in 1892. Collections from the Holothuria Bank and the Macclesfield Bank, in the China Sea, during the period 1888-1893 by the Royal Navy survey vessels, HMS *Rambler*, *Penguin* and *Egeria* also included the following dromiid crabs: *Lauridromia intermedia* (Laurie, 1906), *Dromidiopsis tridentata* Borradaile, 1903, *Petalomera granulata* Stimpson, 1858, *Cryptodromiopsis bullifera* (Alcock, 1900), *C. unidentata* (Ruppell, 1830), *Cryptodromia bilgendorfi* De Man, 1888, and *Epigodromia areolata* (Ihle, 1913). *Petalomera acutidens* Sakai, 1983 is shown to belong to the genus *Epigodromia* McLay, 1993.

KEY WORDS
Crustacea,
Decapoda,
Dromiidae,
new genus,
Alainodromia,
new species,
China Sea.

RÉSUMÉ

Un nouveau genre et une nouvelle espèce de dromie (Brachyura, Dromiidae) de la mer de Timor, au nord-ouest de l'Australie et signalement d'autres espèces de la mer de Chine. Un nouveau genre et une nouvelle espèce de Dromiidae, *Alainodromia timorensis*, sont décrits du banc Holothuria, en mer de Timor, à partir de spécimens récoltés par le HMS *Penguin* en 1892. Les collections provenant du banc Holothuria et du banc Macclesfield, en mer de Chine, prélevés en 1888-1893 par les bateaux de la Royal Navy HMS *Rambler*, *Penguin* et *Egeria*, contiennent aussi les Dromiidae suivants : *Lauridromia intermedia* (Laurie, 1906), *Dromiodopsis tridentata* Borradaile, 1903, *Petalomera granulata* Stimpson, 1858, *Cryptodromiopsis bullifera* (Alcock, 1900), *C. unidentata* (Ruppell, 1830), *Cryptodromia bilgendorfi* De Man, 1888, and *Epigodromia areolata* (Ihle, 1913). Il est montré que *Petalomera acutidens* Sakai, 1983 appartient au genre *Epigodromia* McLay, 1993.

MOTS CLÉS
Crustacea,
Decapoda,
Dromiidae,
nouveau genre,
Alainodromia,
nouvelle espèce,
mer de Chine.

INTRODUCTION

A new genus and species of dromiid crab is described from the Holothuria Bank (13°25'S - 126°00'E) in the Timor Sea near Vansittart Bay, Kimberley, north-west of Australia. The specimens were collected in 1892 by P. Bassett-Smith Surgeon RN, aboard HMS *Penguin* during its cruise in the Australian and China Seas. The Stomatopoda material from this cruise were reported by Pollock (1893). While station information and a preliminary report, focussing mainly on the corals, from the Macclesfield Bank, off the coast of Vietnam (15°40'N - 114°45'E), was presented to the Admiralty by Bassett-Smith (1894), nothing seems to have been reported about the results of dredging on the Holothuria Bank. This area was investigated en route to or from the China Sea. Besides the new species described herein, I also include a list of other dromiids collected from the Holothuria Bank as well as dromiids from the Macclesfield Bank. All of the material reported in this paper is held in the Crustacea collection of the British Museum (BM), London. It is interesting to note that if the dromiid material had been worked up at the same time as the stomatopods, five new species, and as many genera, would have been discovered.

The report by Bassett-Smith (1894) is divided into three parts: Part I lists the stations occupied by HMS *Rambler* (during April, 1888) from stations A to I, Part II lists the stations occupied by HMS *Penguin* (during April, 1892) from stations 1 to 32, and Part III lists the stations occupied by HMS *Egeria* (during April, 1893) from stations 33 to 77. This makes a total of eighty-seven Macclesfield Bank stations which were sampled using dredges and "swabs". While most of the material collected on the first survey in 1888 was listed as corals and sponges, crabs were recorded from stations A, F, and I. In Part II, a footnote mentions a report by Commander W. U. Moore and P. W. Bassett-Smith about the "[...] dredgings obtained on this bank (*i.e.* Macclesfield) by HMS *Rambler*, in 1888, published by the Hydrographic Department of the Admiralty, in March 1889, under the title of 'Reports of the Results of an examination by the officers of HMSV *Rambler* of the slopes and zoological condition of the Tizard and Macclesfield Banks". I have not had the opportunity of consulting this report, but there does not seem to have been any dromiid material collected on the first cruise. On the second survey, in 1892, crustaceans were described as "[...] not plentiful, though among the coral forms, their appearance and shape was often most grotesque and generally strongly protective, those coloured green and red, like the algae in which they lived, even having white irregular spots on them resembling spirorbis shells, etc., others completely hidden in a sponge much larger than themselves which they carried about, or some species of lambris (*sic.*) so entirely like a rocky bottom, that when still it was almost impossible to detect them". This is the only specific reference to sponge crabs (Dromiidae) collected during the second voyage. On the third survey, Brachyura are mentioned for stations 39, 56, 59, 64, and 76. These include a parasitic crab from a *Cidaris* urchin (station 56), and large spider crabs (stations 59, 76). At station 39 "[...] three species of "*Dromia*" carrying large sponges on their back" and at station 64 a species of "*Dromia*" was said to be common. Thus for all the Macclesfield Bank stations dromiids are mentioned only three times.

When the Brachyura collection from these voyages was lodged at the British Museum, the only information included on the labels was the name of the collector (Bassett-Smith), the name of the ship, and the depth (these have been converted from fathoms to metres) along with the accession number. Sometimes the type of bottom was included. Since station numbers from the Macclesfield Bank survey were not included, it is not possible to relate the specimens back to station information with any certainty. The depths which were recorded on the labels do not seem to correspond to the station data. As noted above, the collection from station 39 was reported to contain three species of "*Dromia*". The only sample which contained three dromiid species was No.: 98. 8. 20. 99-110 but the label information does not agree with the information given in the report. However, the label information does agree with station 64

where the report states that a species of "*Dromia*" was common. Therefore I tentatively suggest that some records for *Lauridromia intermedia* (Laurie, 1906), *Petalomera granulata* Stimpson, 1858, and *Cryptodromiopsis bullifera* (Alcock, 1900) may have come from station 64. Linking any of the other specimens with particular stations would be purely speculative. There does not seem to be any data available for the Holothuria Bank stations.

Besides mapping the bathymetry of the Macclesfield Bank, for shipping purposes, the other purpose of the voyage seems to have been to test Darwin's theory about the origin and distribution of coral reefs (Darwin, 1842). Hence the interest of Bassett-Smith in the corals, especially reef-building species. The survey established that the Bank was about 80 miles (130 km) long by 30 miles (50 km) wide with a periphery 200 miles (320 km) long. In his Preface to Bassett-Smith's report, the chief hydrographer, W. J. L. Wharton stated that on the periphery "[...] there exists a rim of coral in luxurious growth, and at a remarkably even depth below the surface of from 9 fms (17 m) to 14 fms (26 m), this rim being broken here and there by passages of greater depth, but less than the general depths of from 40 fms (73 m) to 48 fms (88 m), which prevail over the whole central body of the bank". He concluded by stating "[...] that from the present time onwards no movement (of the bottom) is necessary in order to form in the future a perfect atoll, the simple growth of coral on the rim sufficing; and that we may have here an instance of a suitable original foundation for an atoll so formed, as pointed out by Mr. Darwin".

The terminology and method of presentation used in this paper follows that of McLay (1993), where the full synonymies for each species can be found. The original name and the synonymies given below encompass all the important nomenclatural decisions along with references to published records of specimens already reported from the Macclesfield and Holothuria Banks areas. The only exception is *Petalomera granulata* Stimpson, 1858 which was not included in McLay (1993) and so a full synonymy for this species is included herein.

Family Dromiidae De Haan, 1833

Alainodromia n.g.

Type species. — *Alainodromia timorensis* n.sp., by monotypy.

Etymology. — This new generic name combines "*Dromia*" with the christian name of Dr Alain Crosnier, in recognition of his immense contribution to the study of decapod Crustacea.
Gender feminine.

Diagnosis

Carapace about as wide as long (including rostral and anterolateral teeth), surface weakly convex, granulate and/or tuberculate. Rostrum strongly tridentate, projecting, supraorbital margin well developed. Anterolateral teeth well-developed, some may be bifid, on a much higher level than the rostrum. Coxae of third maxillipeds close together and inserted on the sternal plate which begins just in front of the bases of the chelipeds. Female sternal grooves end close together but separately between bases of first walking legs. Antennal exopod well-developed. Cheliped without an epipod, male chelipeds much larger than those of female. First two pairs of walking legs slightly smaller than chelipeds, tuberculate, dactyli well-developed, inner margins armed with small spines. Last two pairs of legs stout, reduced, dactyli strongly curved, inner propodal margin with single spines, no spines on outer propodal margins. Abdomen of six free segments, strongly ridged and tuberculate. Uropod plates absent. Abdominal locking mechanism involves lateral tubercles on penultimate segment locking in front of tubercles on the base of the first walking legs. Corners of posterior telson margin produced.

Discussion

Alainodromia timorensis n.sp. resembles some of the species belonging to *Takedromia* McLay, 1993, but differs in several important respects. The most distinctive characters of *Alainodromia* n.g. are the approximately pentagonal carapace shape, prominent rostral area, strongly developed, elevated anterolateral teeth, strongly sculptured abdomen and absence of the uropod plates. In addition, the female sternal grooves are

convergent, ending close together. This genus clearly belongs in the group of genera which lack an epipod on the cheliped, such as *Cryptodromia* Stimpson, 1858, *Takedromia* McLay, 1993, and *Epigodromia* McLay, 1993. All of the species belonging to these genera only attain a relatively small size. While the species of *Takedromia* and *Epigodromia* have probably abandoned the habit of carrying pieces of camouflage, the structure of the last two pairs of legs in *A. timorensis* n.sp. suggests that, like the species of *Cryptodromia*, it still employs this habit. The new genus shares with *Takedromia* and *Epigodromia*, and some other dromiids, the characteristic that the chelipeds are strongly sexually dimorphic, being much larger in the male.

Alainodromia timorensis n.sp.
(Figs 1-3)

MATERIAL EXAMINED. — **Holothuria Bank.** HMS *Penguin*, 13°25'S - 126°00'E, 44 m, 1892, coll. P. W. Bassett-Smith: 2 ♂♂, 11.8 × 11.0 mm (holotype, BM 1998: 193), 12.7 × 11.6 mm (paratype, broken, BM 1998: 194). — 27.5 m, no date: 1 ♀ 6.4 × 6.1 mm, 1 ♂, 8.7 × 8.4 mm, both carrying sacculinid parasite externa under the abdomen (BM 1892: 3: 26: 224-225).

DESCRIPTION

Carapace broadly subpentagonal in shape, wider than long, more strongly convex in the anterior-posterior direction, laterally almost flat, surface covered with fine granules, anterior half adorned with about forty larger subacute tubercles bearing long setae. Regions of the carapace weakly defined. Short frontal groove extends back between lateral rostral teeth. Branchial and cervical grooves distinct. Protogastric region with three small tubercles, mesogastric region with seven unequal tubercles, and branchial region with about ten unequal tubercles. Cardiac area slightly convex, finely granulated, well-defined by grooves. Rostrum strongly tridentate, teeth separated by a broad U-shaped sinus, median tooth deflexed but visible dorsally, lateral teeth larger, prominent, directed anteriorly, slightly longer than median tooth. Anterolateral margin with three teeth, begins well behind post-orbital corner, rising quickly to a large antero-dorsally directed tooth which is flattened and bears two or three small tubercles on its posterior margin, followed by a bifid dorso-laterally directed tooth marking the widest part of the carapace, and then the third anterolateral tooth which is flattened like the first tooth and directed laterally. There is some variation in the anterolateral teeth because either of the first two teeth may or may not be bifid. Branchial notch not distinct, posterolateral margins convergent, bearing two or three well-developed tubercles. Posterior carapace margin almost straight. The anterolateral teeth and tuberculated area of the carapace are on a higher level than the rostral area.

Supraorbital border extends back from posterior margin of lateral rostral tooth to a strong supraorbital tooth which is directed almost vertically, remaining supraorbital margin slightly sinuous towards a small postorbital tooth. No orbital fissure, suborbital margin not visible dorsally, finely granulated, with a small tooth near the inner corner.

First segment of antenna much wider than long, granulate, medially beaked, superior lobe longer and bearing several small spines. Second segment longer than wide, convex, granulate, distomedial corner produced as a blunt curved lobe on which third segment is inserted at an angle. Exopod firmly fixed to second segment, granulate, extending beyond joint between third and fourth segments, tip slightly bilobed to accommodate fourth segment of antenna, inner border curved over base of eyestalk. Ratio of length of antennal flagella/CW = 0.56.

Subhepatic area slightly convex, with two small tubercles beneath the first anterolateral tooth and a row of three flattened tubercles curving posteriorly below these. This row of tubercles is on the same level as the anterior margin of the buccal frame. A shallow groove extends around below these tubercles to the branchial groove. Female sternal grooves end close together, but apart on a convex, transverse ridge between bases of first legs. Crista dentata on third maxillipeds armed with about eight similar small spines.

Chelipeds finely granulated, well-developed, much larger in male (length about twice CL), covered in sharp granules. Merus especially long in male, inferior margins bearing several small

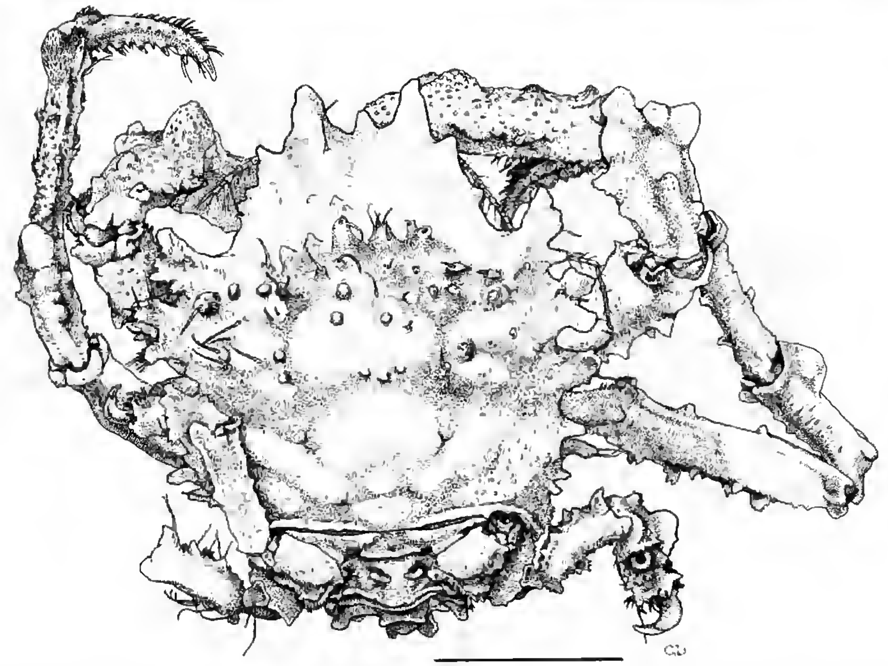


FIG. 1. — *Alainodromia timorensis* n.sp., Holothuria Bank, HMS *Penguin*, 13°25'S - 126°00'E, 44 m, 1892: ♂ holotype 11.8 × 11.0 mm (BM 1988: 193), dorsal view of whole crab (left and right second walking legs, and right fourth leg missing). Scale bar for drawing: 5 mm.

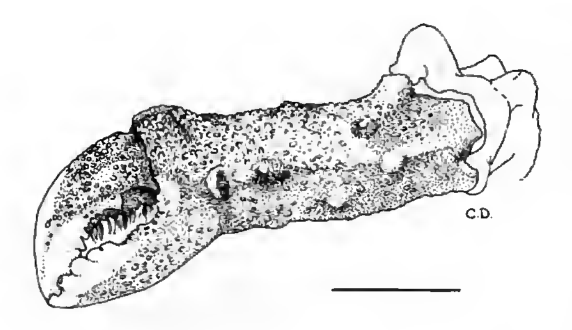


FIG. 2. — *Alainodromia timorensis* n.sp., Holothuria Bank, HMS *Penguin*, 13°25'S - 126°00'E, 44 m, 1892: ♂ holotype 11.8 × 11.0 mm (BM 1998: 193); external surface of left cheliped. Scale bar: 2 mm.

tubercles. Carpus has two small tubercles on the superior border, two similar proximal tubercles, and two obtuse, distal tubercles on the outer face. Propodus especially long in male, outer face has six or seven small tubercles. Fingers strongly downcurved, gaping at base, cutting edges armed with six-seven small teeth, meeting at tips. Inner surface of fingers hollowed out and covered with a dense layer of setae which covers the gap between the fingers.

First two pairs of legs slightly smaller than chelipeds, margins of meri, carpi and propodi armed with a few prominent tubercles, surface otherwise finely granulate. Proximal and distal corners of carpi each have a large, rounded swelling. Dactyli shorter than propodi, inner margins have eight-nine well-developed spines, all of similar size.

Last two pairs of legs stout, reduced, but of similar length, fourth pair subdorsal, folded across posterolateral corners of carapace. Dactyli of both legs well-developed, strongly curved, distal border of propodi bearing single, small propodal spines. The tips of the dactyli are not directly opposable to the propodal spines. No spines on the outer propodal margin.

Abdomen of six free segments. Telson about as wide as long, posterior margin strongly concave with lateral corners produced as subacute lobes. Uropod plates absent. Abdominal locking mechanism consists of lateral projection from the penultimate abdominal segment fitting in front of a tubercle on base of first legs. Median ridge of abdomen strongly developed, giving a W-shape in cross section; on second-sixth segments there is a proximal pair of median tubercles followed by a single distal median tubercle, or ridge, with smaller lateral tubercles on each side. Thus each abdominal segment has five prominent tubercles. Besides the lateral tubercles involved in the abdominal locking mechanism, there is another similar, more distal tubercle following them. Lateral margins of other abdominal segments without tubercles. On the telson there are four small rounded tubercles arranged in a square.

First male pleopod with a semi-rolled, setose tube with sharp tip, second pleopod simple, needle-like. Genital papilla from coxa of last legs, soft and flexible, very long, reaching almost to the joint mid-way along the first male gonopod.

DISCUSSION

This new genus and species is based on four specimens collected from the Timor Sea at depths ranging from 27 to 44 m. Three specimens were



FIG. 3. — *Alainodromia timorensis* n.sp., Holothuria Bank, HMS *Penguin*, 13°25'S - 126°00'E, 44 m, 1892: ♂ holotype 11.8 × 11.0 mm (BM 1998: 193); external surface of abdomen.

males and the other a female, but this animal, as well as one of the males, was infected with a sacculinid parasite. While the male appeared to have fully developed gonopods, the female pleopods were much smaller than might be expected. The two uninfected large males had well-developed chelipeds and gonopods, but the infected small male had smaller chelipeds suggesting that it had not yet passed the pubertal moult. Similarly, judging by the size of the abdomen, the female was also immature. Dromiids carrying sacculinid externa are not very common.

The structure of the last two pairs of legs of *A. timorensis* suggests that it probably carries pieces of camouflage. Species of *Cryptodromia* mainly utilize pieces of sponge or ascidians to conceal their body, changing them regularly during intermoult periods (see McLay 1983).

Lauridromia intermedia (Laurie, 1906)

Dromia intermedia Laurie, 1906: 351. – Ihle 1913: 23, pl. 1, figs 1-3. – Sakai 1936: 10, pl. 6, fig. 1; 1976: 8, pl. 1, fig. 3. – Campbell 1971: 29.

Lauridromia intermedia. – McLay 1993: 146, fig. 15 d.

MATERIAL EXAMINED. — **Holothuria Bank.** HMS *Penguin*: 13°25'S - 126°00'E, 44 m, 1892: 1 ♀, 7.6 × 7.5 mm (BM 92: 3: 26: 226).
Macclesfield Bank. HMS ? *Egeria*, 15°40'N - 114°45'E, ? stn 64, 64-68 m, sand and coral, 1893: 3 ♂♂, 6.2 × 6.8, 7.9 × 7.7, 11.7 × 11.8 mm (BM 98: 8: 20).

DISCUSSION

A full description of *Lauridromia intermedia* can be found in McLay (1993). This is a widespread Indo-Pacific species and it has been recorded from Japan (Sakai 1976) and from the south coast of Timor (Ihle 1913). The above new records do not greatly extend the range of *L. intermedia*. All of these records lie within the known depth range (7-150 m).

Dromidiopsis tridentata Borradaile, 1903

Dromidiopsis tridentatus Borradaile, 1903: 576, pl. 33, fig. 2a.

Dromidia australiensis var. – de Man 1896: 372 (not *D. australiensis* Haswell, 1882).

Dromidiopsis australiensis – Borradaile 1900: 572.

Dromidiopsis tridentata – Balss 1934: 502. – Lewinsohn 1984: 97, fig. 1. – McLay 1993: 141, figs 4a-j, 16a-b.

MATERIAL EXAMINED. — **Macclesfield Bank.** HMS *Egeria*, 15°40'N - 114°45'E, 80 m, 1893: 1 ♀, 8.9 × 9.8 mm (soft) (BM 1893: 11: 3: 264).

DISCUSSION

Dromidiopsis tridentata has been fully described by McLay (1993). The known distribution of this species extends from India through Indonesia to New Caledonia and the Fiji Islands. Thus this record from the Macclesfield Bank extends the range of *D. tridentata* into the China Sea. In the review of the genus *Dromidiopsis* Borradaile, 1900 by McLay (1993) attention was drawn to the anomalous record of Sakai (1976) of *D. abrolhensis* Montgomery, 1931 [a synonym of *D. australiensis* (Haswell, 1882)] from Japan. Lewinsohn (1984) investigated the use of the name *D. tridentata* and showed that many of the supposed records of *D. australiensis* were in fact of the former species. Thus it now seems likely that Sakai probably had a specimen of *D. tridentata* and that the range of this species probably also includes Japan.

Petalomera granulata Stimpson, 1858

Petalomera granulata Stimpson, 1858: 240; 1907: 179, pl. 21, fig. 4. – Alcock 1901: 78 (list). – Ihle 1913: 48 (key), 91 (list). – Gordon 1931: 526 (list). – Sakai 1936: 37, pl. 1, fig. 3, text fig. 10 a-c; 1965, 10, pl. 5, fig. 1; 1976: 25, pl. 4, fig. 4. – Suzuki & Kurata 1967: 95 (list). – Yamaguchi *et al.* 1987: 7, pl. 1, fig. 5. – Dai & Yang 1991: 25, pls 2-3, fig. 7, 1-3.

Petalomera granulata var. *indica* Alcock, 1899: 148. – Urita 1926: 1.

Petalomera indica – Alcock 1901: 55, pl. 3, fig. 14, 14a. – Ihle 1913: 48 (key), 91 (list).

Not *Petalomera granulata* – Shen 1932: 3, pl. 1, figs 9-10, text figs 1-3 (= *Paradromia japonica* Henderson, 1888).

MATERIAL EXAMINED. — **Holothuria Bank.** HMS *Penguin*: 13°25'S - 126°00'E, no depth, 1892: 1 ♂, 8.5 × 9.3 mm, 1 ♀, 10.2 × 11.2 mm (BM 92: 3: 26: 213-214). — 69.6-71.5 m, 1892: 1 ♂, 7.8 × 8.5 mm (BM 92: 3: 26: 215). — 44 m, 1892: 1 ovig. ♀, 7.2 × 7.6 mm, 1 ♀, 9.0 × 9.8 mm (BM

92: 3: 26; 216-217). — 59 m, 1892: 1 ovig. ♀, 8.6 × 9.4 mm (BM 92: 3: 26: 218).
Macclesfield Bank. HMS *Egeria*, 15°40'N - 114°45'E, no depth, 1893: 1 ♂, 8.2 × 8.7 mm (BM 93: 11: 3: 21). — ? stn 64, 64-68 m, sand and coral, 1893: 6 ♂♂, 6.9 × 6.9, 7.2 × 7.8, 9.4 × 9.5, 9.9 × 10.4, 10.6 × 11.3, 11.5 × 11.7 mm, 2 ovig. ♀♀, 9.0 × 9.8, 15.6 × 15.4 mm (BM 98: 8: 20).

DISCUSSION

McLay (1993) revised the genus *Petalomera* Stimpson, 1858, removing all of the species to other genera except for *P. pulchra* Miers, 1884 and *P. granulata* Stimpson, 1858 (the type species of the genus *Petalomera*). This imposed a much more restrictive definition on the genus, emphasizing the fact that the chelipeds and first two pairs of walking legs of these dromiids had petaloid meri (hence the generic name of *Petalomera*). During the nineteenth century, many species without this character were added to the genus at least partly because Borradaile (1903), in his generic revision, omitted petaloid meri from the definition of the genus. The concept of the genus then came to include any small dromiids with an epipod on the cheliped and a granular carapace. Until the revision by McLay (1993) a total of nineteen species had been added. Most of these species have now been assigned to the genera *Stimdromia* McLay, 1993, *Dromia* Weber, 1795, *Tunedromia* McLay, 1993, *Frodromia* McLay, 1993, and *Epigodromia* McLay, 1993. Through an oversight one species, *Petalomera acutidens* Sakai, 1983, was omitted. This species should be known as *Epigodromia acutidens* (Sakai, 1983) because it does not conform to the strict definition of the original genus.

The only other name under which *Petalomera granulata* has been known is *P. indica* Alcock, 1901. This species was synonymized with *P. granulata* Stimpson, 1858 by Sakai (1965).

P. granulata is known from Kagoshima, Japan (the type locality), China (Dai & Yang 1991), Indonesia and Northern Australia (McLay 1993) and the Andaman Islands and Sri Lanka (Alcock 1901, as *P. indica*). Thus the records of *P. granulata* from the Macclesfield and Holothuria Banks does not really extend the range of this species. The previously known depth range for *P. granulata* was 30-80 m, so the new records (44-70 m) do not extend this range.

The occurrence of ovigerous females provides new information about the reproduction of *P. granulata*: egg numbers ranged from 80 (CW 7.2 mm) to 760 (CW 15.6 mm), and the mean egg diameter was 0.77 mm. The comparable data for *P. pulchra* are 120 to 1278 eggs (CW 6.7 to 19.9 mm) with a mean egg diameter of 0.7 mm (McLay 1993). Thus, the reproductive strategies of these two species are probably very similar. In *P. pulchra* the female pubertal moult occurs over a comparatively wide size range (CW 6.7 to 11.8 mm) but whether the same phenomenon occurs in *P. granulata* is not clear because only six females [four ovigerous and two non-ovigerous (CW 9.0-10.2 mm)] were available. Unfortunately, the abdomen width of the non-ovigerous females was not measured.

Cryptodromiopsis bullifera (Alcock, 1900)

Dromia (*Cryptodromia*) *bullifera* Alcock, 1900: 143.

Cryptodromia bullifera – Ihle 1913: 40. – Sakai 1936: 23, pl. 7, fig. 3; 1976: 16, text fig. 8. – Ward 1941: 1.

Cryptodromiopsis bullifera – McLay 1993, 189, fig. 17 e.

MATERIAL EXAMINED. — **Holothuria Bank.** HMS *Penguin*: 13°25'S -126°00'E, 69.6-71.5 m, 1892: 2 ovig. ♀♀, 5.2 × 4.9, 6.4 × 6.3 mm (BM 92: 3: 26: 220-221). — 97 m, 1892: 1 ♂, 7.7 × 7.7 mm (BM 92: 3: 26: 222).
Macclesfield Bank. HMS *Penguin*: 15°40'N - 114°45'E, 55-92 m, 1892: 1 ♂, 4.5 × 4.3 mm (sponge cap) (BM 1984: 523). — ? stn 64, 64-68 m, sand and coral, 1893: 1 ovig. ♀, 6.1 × 6.0 mm (BM 1984: 516).

DISCUSSION

Cryptodromiopsis bullifera has been fully described by McLay (1993). Its distribution ranges from the Red Sea to the Philippine Islands and north to Japan. Therefore the new records do not extend the known range for this species. McLay (1993) concluded that the depth range for *C. bullifera* was from 0-60 m, but one of the specimens from the Holothuria Bank came from 97 m (53 fathoms). This small male extends the lower depth limit to almost 100 m.

All of the female specimens reported here were ovigerous and they provide the first information about the reproduction of *C. bullifera*. The females were all of a similar size and the number of eggs ranged from thirty to sixty, with a mean egg size of 0.7 mm. As noted by McLay (1993), this species reaches maturity at a very small size (CW 5.0 mm). The egg size for *C. bullifera* is similar to that of *C. unidentata* (0.75-1.10 mm) but this species does not reach sexual maturity until they are about CW 11.0 mm. Not surprisingly, egg numbers (range 216-440, mean 331) are higher for *C. unidentata*.
One of specimens reported by McLay (1993) carried a compound ascidian cap and the present collection includes a small male carrying a sponge cap. Thus *C. bullifera* seems to use similar camouflage material to other small dromiids.

Cryptodromiopsis unidentata (Ruppell, 1830)

Dromia unidentata Ruppell, 1830: 16, pl. 4, fig. 2, 2a, pl. 5, fig. 9.

Dromidia unidentata – Nobili 1903: 23. – Rathbun 1910: 367. – Ihle 1913: 31. – Sakai 1936: 13, pl. 6, fig. 2, text fig. 2; 1976: 11, pl. 2, fig. 2, text fig. 2 a-b.

Cryptodromia unilobata Campbell *et* Stephenson, 1970: 240, fig. 2A-I.

Cryptodromiopsis unidentata – McLay 1993: 192, figs 7 a-k, 18 a.

MATERIAL EXAMINED. — **Macclesfield Bank.** HMS *Egeria*, 15°40'N - 114°45'E, 46 m, 1893: 1 ♂, 6.4 × 6.6 mm (sponge cap) (BM 1893: 11: 3: 263).

DISCUSSION
Cryptodromiopsis unidentata has been fully described and figured by McLay (1993). It is a very widespread species from the Red Sea and coast of Africa through the Indian Ocean to the Pacific where it occurs as far south as the Kermadec Islands, north of New Zealand, as far north as Japan, and to the east as far as Hawaii and Easter Island. Thus the occurrence of *C. unidentata* on the Macclesfield Bank is not surprising.
Among the Dromiidae, *C. unidentata* has the most catholic tastes when it comes to camouflage: it has been recorded as carrying pieces of a variety of sponges, both compound and solitary ascidians, as well as actinaria (McLay 1993). The specimen from the Macclesfield Bank was carrying a piece of sponge.

Cryptodromia hilgendorfi de Man, 1888

Cryptodromia hilgendorfi de Man, 1888: 404, pl. 18, fig. 3. – Borradaile 1900: 571. – Ihle 1913: 45. – Buitendijk 1939: 224. – Takeda 1973: 78. – Campbell & Stephenson 1970: 245, fig. 3 A-C. – Rodgers & Olerod 1988: 303. – McLay 1982: 317; 1993: 205, fig. 18 d. – Dai & Yang 1991: 24, pl. 2 (2), fig. 6 B.

MATERIAL EXAMINED. — **Macclesfield Bank.** HMS *Penguin*: 15°40'N - 114°45'E, 55-92 m, 1892: 1 ♂, 5.5 × 5.3 mm (sponge cap), 1 ♀, 5.8 × 5.4 mm (sponge cap, BM 1998: 195-196). — HMS *Egeria*, 15°40'N - 114°45'E, 80 m, 1893: 1 ♂, 6.9 × 6.1 mm (sponge cap) (BM 1893: 11: 3: 194).

DISCUSSION
Cryptodromia hilgendorfi has been figured by McLay (1993) and by Campbell & Stephenson (1970) who include an illustration of the first male pleopod (see also Dai & Yang 1991). This is a widespread Indo-Pacific species that has already been recorded from the coast of China by Dai & Yang (1991). Both specimens from the Macclesfield Bank were carrying sponges which is typical for *C. hilgendorfi*. The only detailed study of the camouflage behaviour of any dromiid was carried out in Moreton Bay, Australia (McLay 1983). Here *C. hilgendorfi* used at least twelve different sponges as well as three ascidians for camouflage. Both of the Macclesfield Bank specimens came from near the known lower depth limit of this species (range 0-88 m).

Epigodromia areolata (Ihle, 1913)

Cryptodromia areolata Ihle, 1913: 47, pl. 2, figs 10-11. – Sakai 1936: pl. 1, fig. 1; 1965: 8, pl. 3, fig. 4; 1976: 17, pl. 4, fig. 2. – Takeda & Miyake 1970: 202; 1972: 66. – Campbell 1971: 29. – Serene & Lohavanijaya 1973: 18, pl. 2A, figs 5-7. – Dai & Yang 1991: 25, pl. 1 (8).

Epigodromia areolata – McLay 1993: 217, fig. 19 e-f.

MATERIAL EXAMINED. — **Macclesfield Bank.** HMS *Egeria*, 15°40'N - 114°45'E, 132 m, 1893: 1 ♂, 12.0 × 11.6 mm (BM 93: 11: 5: 262).

Discussion

Epigodromia areolata has been illustrated by Ihle (1913), Sakai (1976), and McLay (1993), while the male pleopod has been figured by Serene & Lohvanijaya (1973). A feature of this species is that males have much larger chelipeds than females of the same size. This species has proved to be abundant in collections from Japan and the South China Sea (Takeda & Miyake 1972). *E. areolata* is only known from a fairly narrow latitudinal band from Japan in the north to New Caledonia in the south. The maximum size for a male of this species is CW 12.3 mm, so the Macclesfield Bank specimen is near the upper limit. This specimen also lies within the known depth range of 30-350 m.

In the review by McLay (1993) of *Epigodromia* McLay, 1993, one species, which belongs in this genus, was overlooked. *Petalomera acutidens* Sakai, 1983, from Japan, should be known as *Epigodromia acutidens* (Sakai, 1983). In this species the anterolateral margin is armed with five or six sharp teeth. This brings to ten the number of species of *Epigodromia*.

Acknowledgements

I am very grateful to Paul Clark, British Museum, who kindly made the Holothuria and Macclesfield Bank dromiid material available for study, and who has waited a long time for this report (although not as long as the specimens remained unreported in the British Museum collection)! I am grateful to Clinton Duffy who expertly drew the figures.

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A new genus of Galatheidae (Crustacea, Anomura) from the Western Pacific Ocean

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ABSTRACT

A new genus, *Crosnierita*, is established for three species of galatheid crustaceans: *C. dicata* n.sp., *Munida urizae* Macpherson, 1994 and *M. yante* Macpherson, 1994, the latter two having been transferred to the genus *Agononida*. The new genus is characterized by the absence of male pleopods on the first abdominal segment, the frontal margin deeply concave, the lateral margin of the basal antennular segment bearing two spines in addition to the distal spines, the third and fourth segments of the antennal peduncle reduced in size and the merus of the third maxilliped very short. All these characters suggest that the new genus approaches *Bathymunida* Balss, 1914 and its relatives.

KEY WORDS
Crustacea, Decapoda, Galatheidae, *Crosnierita*, new genus, new species, Pacific Ocean.

RÉSUMÉ

Un nouveau genre de Galatheidae (Crustacea, Anomura) de l'océan Pacifique occidental. Le nouveau genre *Crosnierita* est établi pour trois espèces de crustacés galathéides : *C. dicata* n.sp., *Munida urizae* Macpherson, 1994 et *M. yante* Macpherson, 1994, ces deux dernières espèces ayant été précédemment placées dans le genre *Agononida*. Le nouveau genre est caractérisé par : l'absence de pléopodes sur le premier segment abdominal des mâles ; le bord rostral profondément concave ; le bord latéral du segment basal des antennules portant deux épines en plus des épines distales ; les troisième et quatrième segments du pédoncule antennaire de taille réduite et avec le mérus du troisième maxillipède très réduit. Cet ensemble de caractères suggère que ce nouveau genre est proche de *Bathymunida* Balss, 1914.

MOTS CLÉS
Crustacea, Decapoda, Galatheidae, *Crosnierita*, nouveau genre nouvelle espèce, océan Pacifique.

INTRODUCTION

In a recent paper, Baba & de Saint Laurent (1996) established the genus *Agononida* for the species of *Munida* Leach, 1820 that are characterized by the lack of male gonopods on the first abdominal segment. A more thorough study showed that the two previously described species [*Agononida urizae* (Macpherson, 1994) from New Caledonia, Matthew and Hunter Islands and Chesterfield Islands and *A. yante* (Macpherson, 1994) from New Caledonia] and a new species from Loyalty Islands and Vanuatu (see below) here described can be placed in a genus rather different than *Agononida* and more or less close to *Bathymunida* Balss, 1914.
The terminology used in this paper follows previous papers (*e.g.* Macpherson & de Saint Laurent 1991; Macpherson 1994; Baba & de Saint Laurent 1996). Measurements given are of carapace length excluding rostrum. Colour notes are taken from slides by P. Laboute. The types of the new species have been deposited in the collections of the Muséum national d'Histoire naturelle, Paris (MNHN) and the National Museum of Natural History, Washington (NMNH).

Genus *Crosnierita* n.g.

TYPE SPECIES. — *Crosnierita dicata* n.sp. by present designation.

ETYMOLOGY. — The generic name is dedicated to Alain Crosnier, in acknowledgement to his enormous generousity, friendship and his effort in the improvement of the crustacean collections.
Gender: feminine.

DIAGNOSIS
Carapace with transverse ridges, usually granulated. Rostral spine spiniform, clearly overreaching supraocular spines; supraocular spines spiniform, well-developed, but nor overreaching end of corneae. Pair of epigastric spines situated directly behind supraocular spines. Median gastric and cardiac spines sometimes present. Pair of postcervical spines present, not followed by additional spines. Frontal margins deeply concave. Anterolateral spines strong. Branchial margins with four spines. Second to fourth abdominal tergites with two moderately elevated transversal ridges, each anterior ridge bearing four to six spines; a median spine on posterior ridge of fourth tergite. Telsonal subdivision incomplete. Fourth thoracic sternite with anterior margin wide, moderately concave; sixth and seventh sternites without granules or keels. Eyes large, corneae strongly dilated, maximum corneal width equal to or more than one third distance between anterolateral spines. Antennular basal segment with two distal spines; two additional well-developed spines on lateral margin, subdistal spine longer than proximal spine. Antennal basal segment with distomesial spine short, usually not reaching end of second segment; second segment not reduced, with well-developed distal spines, distomesial spine clearly overreaching antennal peduncle; third and fourth segments reduced. Antennal flagellum longer than chelipeds. Merus of third maxilliped clearly shorter than ischium, subrhomboidal in lateral view, with distal spine on extensor margin and with strong marginal spine near midlength of flexor border. Chelipeds slender, elongated, usually longer and stouter in male than in female. Walking legs long and slender; dactyli slender, curving, without lateral keel, flexor margin with spine-like setae. Chelae of fifth pereopods more setose in male than in female and fingers shorter than hand. Flexor face of fifth pereopods with long and sparse simple setae. In male, movable finger with a dense set of setae on proximal part. Male gonopods absent from first abdominal segment.

REMARKS
The strongly excavated frontal margin and the extremely short merus of the third maxilliped link this new genus to *Bathymunida* Balss, but their relationships are rather distant. *Crosnierita* may be easily differentiated from *Bathymunida* by the following characters: (1) rostral and supraocular spines spiniform and well-developed; (2) absence of strong gastric and cardiac processes; (3) presence of a median spine on posterior ridge of fourth abdominal segment; (4) presence of well-developed spines on lateral margin of basal antennular peduncle; and

(5) absence of toothbrush-like setae on the flexor face of fifth pereiopods.

The new genus also resembles *Agononida* Baba *et* de Saint Laurent in the ornamentation of the rostrum, carapace and abdomen. However, *Crosnierita* is easily separated from that genus by the shape of the front margin, the size of the third and fourth segments of the antennal peduncle and the shape of the third maxilliped.

KEY TO SPECIES OF *Crosnierita*

1. Longitudinal row of spines on cardiac region .... *C. dicata*

— Spines absent on cardiac region 2

2. Median spine on metagastric region. Posterior border of carapace with a median spine .... *C. urizae*

— No median spine on metagastric region. Posterior border of carapace unarmed .... *C. yante*

Crosnierita dicata n.sp.
(Fig. 1)

TYPE MATERIAL. — The male of 8.9 mm from MUSORSTOM 6, stn 419 (MNHN-Ga 4241) has been selected as holotype; the other specimens are paratypes (see below).

MATERIAL EXAMINED. — **Loyalty Islands.** MUSORSTOM 6, stn 419, 20°41.65'S - 167°03.70'E, 283 m, 16.II.1989: 7 ♂♂, 7.2 to 9.3 mm; 9 ovig. ♀♀, 7.4 to 8.6 mm; 4 ♀♀, 7.2 to 8.7 mm (MNHN-Ga 4242, NMNH).
Vanuatu. MUSORSTOM 8, stn 963, 20°20'S - 168°49'E, 400-440 m, 21.IX.1994: 1 ovig. ♀, 8.2 mm (MNHN-Ga 4243). — Stn 1017, 17°53'S - 168°26'E, 294-295 m, 27.IX.1994: 2 ♂♂, 7.9 and 8.4 mm (MNHN-Ga 4244). — Stn 1018, 17°53'S - 168°25'E, 300-301 m, 27.IX.1994: 1 ♀, 6.2 mm (MNHN-Ga 4245).

ETYMOLOGY. — From the Latin *dico*, dedicate.

DISTRIBUTION. — Loyalty Islands, Vanuatu, between 283 and 440 m.

DESCRIPTION

Carapace with few secondary striae. Strong median spine in anterior part of metagastric region. Cardiac region with a row of four median spines decreasing in size posteriorly, posteriormost spine small, sometimes absent. Two postcervical spines, each sometimes bearing accompanying small spine behind. Posterior margin of carapace unarmed. One small marginal spine behind and lateral to anterolateral orbital spine. Thoracic sternites with numerous short arcuate striae. Second abdominal segment with six spines on anterior ridge, two median spines larger than lateral spines; third and fourth segments with four spines, two median spines larger than lateral spines; posterior ridge of fourth segment with median spine. Basal antennular segment (distal spines excluded) terminating in anterior end of cornea, distolateral spine longer than distomesial. Basal antennal segment with distomesial spine short, ending in midlength of second segment; distomesial spine on second segment clearly exceeding peduncle, distolateral spine half length of distomesial spine; third segment spineless. Extensor border of merus of third maxilliped with distal spine. Chelipeds slender, opposable margins of fingers denticulated; some small spines on proximal half of movable finger. Dactylus of walking legs more than half that of propodus, proximal half of flexor border with some spinules.

COLORATION

Ground colour of carapace pinkish; numerous yellow and reddish spots on carapace and abdominal segments; two purple spots on posterior

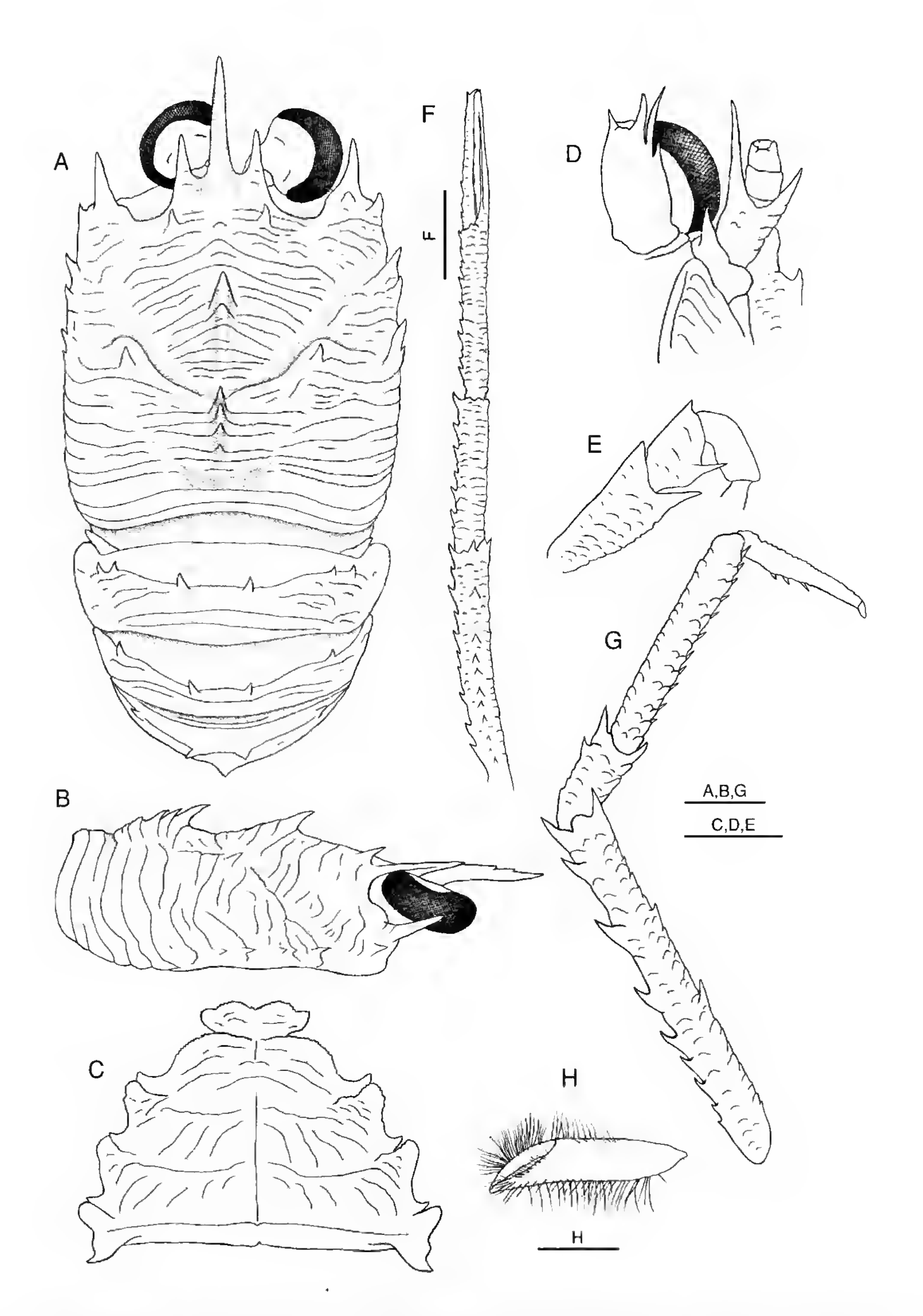


FIG. 1. — *Crosnierita dicata* n.sp., holotype ♂, 8.9 mm; **A**, carapace and abdomen, dorsal view; **B**, carapace, lateral view; **C**, sternal plastron; **D**, ventral view of cephalic region, showing antennular and antennal peduncles; **E**, right third maxilliped, lateral view; **F**, right cheliped, dorsal view; **G**. right first walking leg, lateral view; **H**, right fifth pereopod, distal segments, lateral view. Scale bars: A-E, G, 2 mm; F, 5 mm; H, 1 mm.

part of gastric region; red spots on lateral parts of abdominal segments. Rostrum, supraocular and anterolateral spines pinkish. Chelipeds and walking legs with red and pinkish bands; cheliped palm with distal third red; fingers with proximal two thirds reddish, distal third whitish; distal part of dactylus of walking legs reddish.

REMARKS

C. dicata is closely related to *C. urizae* (Macpherson, 1994) from New Caledonia, Matthew and Hunter Islands and Chesterfield Islands and *C. yante* (Macpherson, 1994) from New Caledonia. However, the new species differs easily from the other species of the genus by the presence of a strong median spine in the anterior part of the metagastric region and a longitudinal row of median spines in the cardiac region.

Acknowledgements

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A new genus and species of pinnotherid crab (Crustacea, Decapoda, Brachyura) from Indonesia

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KEY WORDS
Crustacea,
Decapoda,
Brachyura,
Alain crosnieri,
new genus,
new species,
holothurians.

ABSTRACT
Seven specimens of *Alain crosnieri* n.g., n.sp., were taken off Maluku, Indonesia in holothurians, genus *Molpadia*, during the KARUBAR Expedition 1991 in depths of 399-405 and 457-461 m. *Alain crosnieri* is unique among members of the Pinnotherinae in having only six abdominal somites in the male, with the second and third somites fused. It also is only the second member of the Pinnotherinae to be taken in depths greater than 400 m and to be represented by an androgynous male.

MOTS CLÉS
Crustacea,
Decapoda,
Brachyura,
Alain crosnieri,
nouveau genre,
nouvelle espèce,
holothuries.

RÉSUMÉ
Un nouveau genre et une nouvelle espèce de crabe Pinnotheridae (Crustacea, Decapoda, Brachyura) d'Indonésie. Sept spécimens d'*Alain crosnieri* n.g., n.sp., ont été récoltés dans l'archipel des Moluques, en Indonésie, au cours de l'expédition KARUBAR en 1991. Cette espèce est un commensal intestinal d'holothuries du genre *Molpadia*, vivant à des profondeurs comprises entre 399 et 461 m. *Alain crosnieri* est le seul membre de la sous-famille des Pinnotherinae à posséder seulement six somites abdominaux chez le mâle, les deuxième et troisième somites étant fusionnés. C'est également le second membre des Pinnotherinae prélevé à des profondeurs supérieures à 400 m et représenté par un mâle androgyne.

INTRODUCTION

Among the specimens collected during the KARUBAR Expedition 1991 to Indonesia were two lots of a pinnotherid which Alain Crosnier sent to me for study. These were all taken in holothurians, genus *Molpadia* Cuvier, 1817, from depths of 405-399 and 457-461 m, an unusually deep habitat for a pinnotherid crab. Although these specimens superficially resemble those species of *Pinnotheres* s.l. known from holothurians and included in Part III of Bürger's (1895: 364) key as well as those species listed by Schmitt *et al.* (1973: 13) as associates of holothurians, the crab represented in the KARUBAR collections proved to belong to a new genus and species, named herein.

The female holotype and four paratypes are in the collections of the Muséum national d'Histoire naturelle, Paris, France (MNHN); two paratypes are in the collections of the National Museum of Natural History, Smithsonian Institution, Washington, D. C. (USNM).

ABBREVIATIONS

cl	carapace length, measured on the midline;
cb	carapace breadth;
CC	shrimp trawl used at KARUBAR stations;
CP	beam trawl used at KARUBAR stations;
fm	fathoms;
m	meters;
mm	millimeters;
MXP2	second maxilliped;
MXP3	third maxilliped;
n	number;
PLP(s)	pleopod(s);
Stn	station;
WL1-4	first to fourth walking legs.

Sizes are expressed as cl × cb. All measurements are in millimeters.

SYSTEMATICS

Family PINNOTHERIDAE De Haan, 1833
Subfamily PINNOTHERINAE De Haan, 1833
Alain n.g.

TYPE SPECIES. — *Alain crosnieri* n.sp., by present designation and monotypy. The gender is masculine.

ETYMOLOGY. — Dedicated to my friend and colleague, Alain Crosnier, whose unmatched energy, interest, and abilities in the field have added so much to our knowledge of the decapod and stomatopod crustaceans of West Africa, Madagascar, the Philippines, Indonesia, New Caledonia, and Tahiti, indeed, anywhere he has had the opportunity to make collections. His collecting ability is matched only by his interest in sharing material with other museums and seeing the fruits of his labors studied and published upon by his colleagues around the world.

HOST. — A holothurian, genus *Molpadia*, collected in depths of 399-405 m and 457-461 m.

DIAGNOSIS

Size moderately large, females as large as cl 11.7, cb 13.0. Carapace firm, subcircular, 1.1 to 1.2 times broader than long (appearing 1.0 in Fig. 1A), widest near midlength. MXP3 with ischium and merus fused, 3-segmented exopod present; palp 3-segmented; propodus spatulate, longer than carpus; dactylus spatulate, narrower than propodus, inserted near midlength of lower margin of propodus, and extending beyond its apex. WL1-4 similar, subequal right and left; dactyli of WL1-2 similar, subequal in length, shorter than subequal dactyli of WL3-4. Abdomen of six somites in male, somites 2 and 3 fused; abdomen with seven somites in female.

REMARKS

This new genus can be distinguished from all other genera now recognized in the Pinnotherinae by the fusion of abdominal somites 2 and 3 in the male. As pointed out by me (1993: 127, 128), members of only two genera, *Juxtafabia* Campos, 1993 and *Ernestotheres* Manning, 1993, are known to have only six abdominal somites in the male. In *Ernestotheres* somites 5 and 6 are fused, whereas in *Juxtafabia* somites 4 and 5 are fused. *Ernestotheres* further differs from *Alain* and *Juxtafabia* in having the dactyli of the walking legs subequal; in *Alain* and *Juxtafabia*, the dactyli of WL3-4 are the longest of all dactyli.

I have been able to find only one other record of a member of the Pinnotherinae living in depths of more than 400 m, *Pinnotheres abyssicola* Alcock *et* Anderson, 1899. It was taken off the Travancore coast of India in 430 fm (787 m) in a bivalve,

genus *Lima* Bruguiere, 1797. The unique ovigerous female of *P. abyssicola* apparently has never been figured. It probably should be referred to a new genus, as the distal segment of MXP3 is styliform and articulated terminally on the subdistal segment; Alcock & Anderson (1899) did not mention whether the palp is composed of two or three segments. It also differs from *Alain crosnieri* in having long, slender walking legs, with the dactyli of WL1 and two longer than those of the other two legs. Some species of the genus *Fabia* Dana, 1851, e.g., *Fabia emiliai* (Melo, 1971) and *F. felderi* Gore, 1986 also have two abdominal somites fused (E. Campos, *in litt.*).

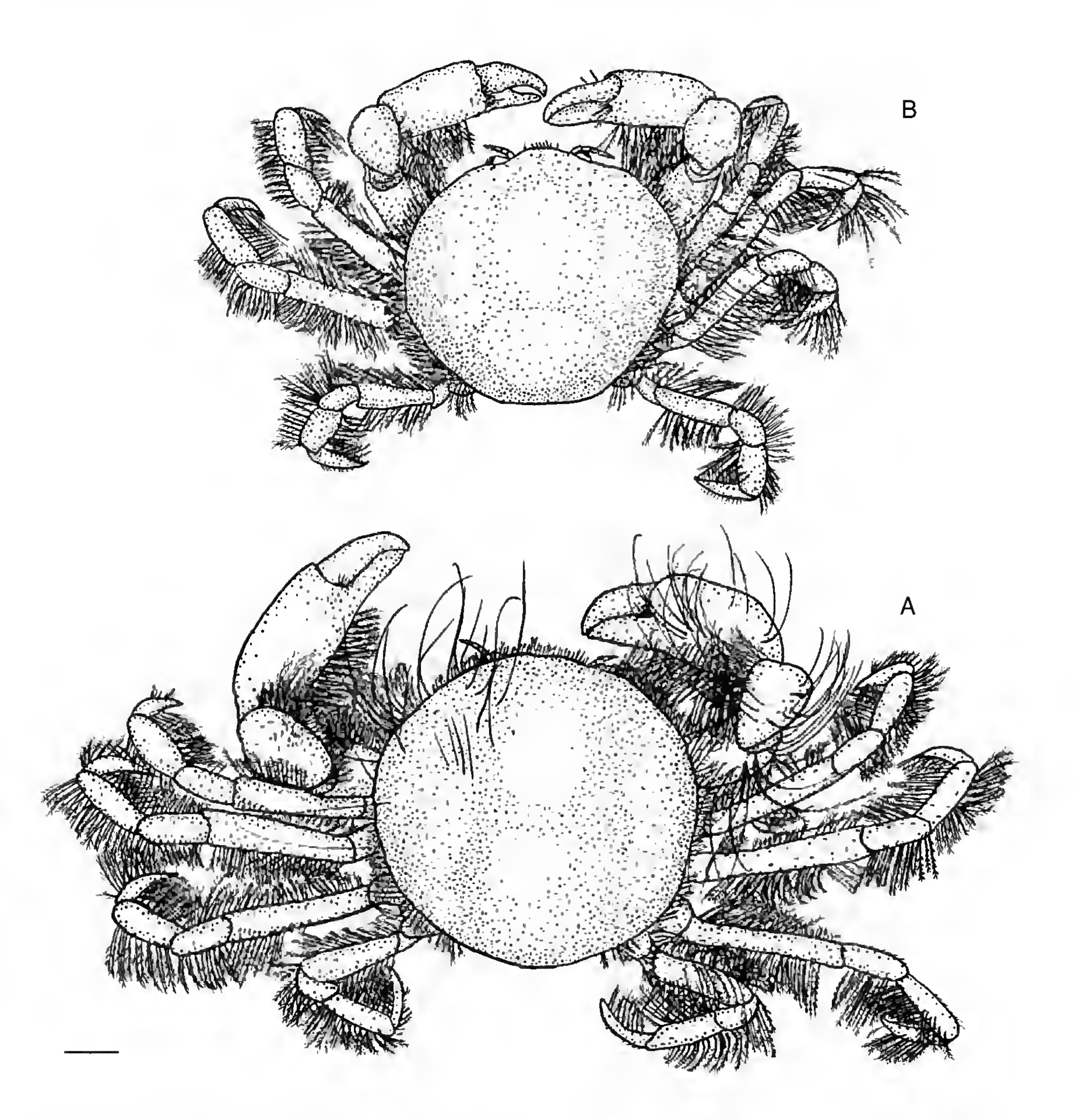


Fig. 1. — *Alain crosnieri* n.g., n.sp.; **A**, ♀ paratype, 11.7 × 13.0 mm, dorsal view; **B**, androgynous male paratype, 7.6 × 8.3 mm, dorsal view (left WL3 missing) (both MNHN-B 26142). Scale bar: 2 cm.

Alain crosnieri n.sp.
(Figs 1-3)

MATERIAL. — **Indonesia**, Maluku, KARUBAR Expedition, stn CP 59, 8°20'01"S - 132°09'32"E, 399-405 m., 31.X.1991: 3 ♂♂, 8.3 × 9.5, 8.3 × 10.0 and 9.4 × 10.6; 2 ♀♀, 9.9, 8.2 × 9.5 and 10.4 × 11.2 [♀, 8.2 × 9.5 is holotype (MNHN-B 26140) and 2 ♂♂ are paratypes (MNHN-B 26141); 1 ♂ and 1 ♀ are paratypes (USNM 264723)]. — Stn CC 58, 8°21'47"S - 132°00'55"E, 457-461 m, 31.X.1991: 1 ♂, 7.6 × 8.3, 1 ♀, 11.7 × 13.0 (paratypes, MNHN-B 26142).

SIZE RANGE. — 4 ♂♂, 7.6 × 8.3 to 9.4 × 10.6; 3 ♀♀, 8.2 × 9.5 to 11.7 × 13.0.

DISTRIBUTION. — Known only from off Maluku, Indonesia.

ETYMOLOGY. — See etymology for genus, above.

DESCRIPTION

Female (Fig. lA) similar to male but larger; much more setose, especially on the walking legs; and abdomen with seven rather than six somites. Size large, cb to at least 13 mm. Carapace firm, subcircular, width 1.1-1.2 times length (appearing 1.0 in Fig. 1A). Anterolateral surfaces almost vertical. Surface punctate, regions poorly defined. Front scarcely projecting, broadly V-shaped in anterior view. Eyes not visible in dorsal view. Margin of carapace, other than posterior, lined with plumose setae, larger and denser above base of cheliped. Dorsal surface of carapace with few very long, simple setae.

Cheliped with numerous long, simple setae on carpus and palm; movable finger half as long as palm; chela with finger tips appressed in distal third, tips not crossing; movable finger with tooth in proximal third, fixed finger with larger, irregular tooth in distal third; setae present in gape of chela; inner, lower surface of chela densely setose. Carpus densely setose on inner surface. Merus densely setose on inner, ventral distal, and outer proximal surfaces.

WL equal right and left, all segments densely setose, WL2-3 with swimming setae. Dactyli of walking legs simple, similar, dactyli of WL1-2 subequal in length, shorter than subequal dactyli of WL3-4. Propodus of WL4 shortest of all propodi of walking legs. WL1 reaching beyond base of dactylus of WL2 when extended, dactylus 0.7 times as long as propodus, latter about 2.5 times longer than high, 1.3 times longer than carpus; merus 2 times as long as carpus. WL2 with dactylus 0.67 times as long as propodus, latter 2.7 times longer than high, 1.2 times longer than carpus; merus 2 times as long as carpus. WL3 with dactylus 1.2 times as long as propodus, latter 2.9 times longer than high, 1.2 times longer than carpus; merus 2 times as long as carpus. WL4 with dactylus 1.2 times as long as propodus, latter 2.3 times longer than high, 0.9 times as long as carpus; merus 1.3 times as long as carpus.

Abdomen with seven somites, reaching to bases of walking legs and MXP3, margin lined with long setae. Four pairs of biramous pleopods present, one pair each on somites 2-5.

Male (Fig. 1B) smaller than female; size large, cb to about 11 mm; much less setose than female, setae present in same areas but sparser and shorter. Swimming setae present on WL2-3. Carapace firm, 1.1-1.2 times broader than long, front scarcely projecting, eyes visible in dorsal view. Chelae with finger tips crossing, opposable margins of fingers armed as in female. Cheliped (Fig. 2C) with movable finger longer than that of female, 0.8 times as long as palm, latter 1.3 times longer than high. WL (Fig. 2D-G) as in female, propodus of WL4 shortest of propodi of walking legs. Proportions of walking legs similar to those of female, differing in having a stouter propodus on WL3-4. Abdomen (Fig. 2H) of male very broad, hourglass-shaped, only six somites present, somites 2-3 fused. Male PLP1 (Figs 2J, K) a simple tube; in androgynous male PLP2 and poorly developed biramous female pleopod both present on fused somites 2-3 (Fig. 2I); uniramous female pleopods present on somites 4 and 5 (Fig. 2I). Female gonopores present.

REMARKS

This is only the second species of Pinnotherinae in which androgynous males are known. The other species is *Nepinnotheres androgynus* Manning, 1993, from Senegal. In *A. crosnieri*, the male has two gonopods and three female-like pleopods (Fig. 2I); in figure 2I the first pair of gonopods has been removed and is not shown.

FIG. 2. — *Alain crosnieri* n.g., n.sp., androgynous ♂ paratype, 7.6 × 8.3 mm (MNHN-B 26142); **A**, MXP3; **B**, MXP2; **C**, cheliped; **D-G**, WL1-4; **H**, abdomen, dorsal (outer) view; **I**, abdomen, ventral (inner) view, ♂ PLP1 removed; **J**, gonopod; **K**, apex of gonopod. (Setae omitted in Fig. 2A-H.). Scale bars: A, B, 10 mm; C-I, 2 mm; J-K, 2 mm; L, 10 mm.

The proportions of the merus, carpus, propodus and dactylus of each of the walking legs of the female are shown diagrammatically in figure 3.

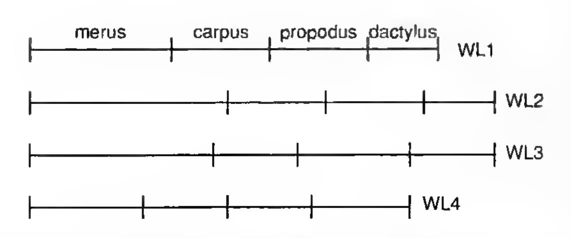


FIG. 3. — *Alain crosnieri* n.g., n.sp., ♀, diagrammatic representation of merus, carpus, propodus, and dactylus of WL1-4.

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Le genre *Eutrichocheles* Wood Mason, 1876 (Crustacea, Decapoda, Thalassinidea) en Polynésie française et au Vietnam avec description de deux espèces nouvelles

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MOTS CLÉS
Crustacea,
Decapoda,
Thalassinidea,
Axiidae,
Eutrichocheles,
systématique,
Indo-Pacifique.

RÉSUMÉ
Trois espèces d'*Eutrichocheles* Wood Mason, 1876 dont deux nouvelles, provenant de Polynésie française et du Vietnam sont décrites. Elles sont comparées aux taxons voisins et l'un de ces derniers, *Eutrichocheles modestus* (Herbst, 1796) est revu plus en détail ; une diagnose est présentée. L'étude du nouveau matériel conduit à quelques modifications dans la diagnose du genre *Eutrichocheles*.

KEY WORDS
Crustacea,
Decapoda,
Thalassinidea,
Axiidae,
Eutrichocheles,
taxonomy,
Indo-Pacific.

ABSTRACT
The genus Eutrichocheles *Wood Mason, 1876 (Crustacea, Decapoda, Thalassinidea) in French Polynesia and in Vietnam with description of two new species.* Three species of *Eutrichocheles* Wood Mason, 1876 from French Polynesia and Vietnam are described, two of them new. They are compared to related taxa, of which *Eutrichocheles modestus* (Herbst, 1796) is reviewed in more detail and a diagnosis presented. Examination of new material has resulted in some amendements to the diagnosis of the genus *Eutrichocheles*.

INTRODUCTION

Le genre *Eutrichocheles*, établi par Wood Mason en 1876 pour y inclure l'espèce *Cancer modestus* Herbst, 1796, a d'abord été placé parmi les Astacidea Nephropidae (voir Holthuis, 1986). Par la suite, Balss (1933) et Chopra (1933), ainsi que des auteurs plus récents, notamment Sakai & de Saint Laurent (1989) et Poore (1994), partagent un avis différent qui est de considérer ce genre comme un membre des Axiidae.

Huit espèces d'*Eutrichocheles* sont connues jusqu'à présent : *E. modestus* (Herbst, 1796) (espèce-type), *E. brocki* (de Man, 1888), *E. defensus* (Rathbun, 1901), *E. bisquamosa* (de Man, 1905), *E. johnstoni* (Edmondson, 1925), *E. pindatyba* Rodriguez *et* Kensley, 1991, et les deux plus récemment décrites, *E. austrinus* Sakai, 1994 et *E. pumilus* Sakai, 1994. Deux de ces espèces proviennent de l'ouest Atlantique, *E. defensus* de Porto Rico et *E. pindatyba* du Brésil ; les autres sont originaires de l'Indo-Pacifique. Ce sont des espèces rares et, à l'exception d'*E. brocki* et *E. austrinus* qui comptaient respectivement trois et deux spécimens-types, toutes les autres, l'espèce-type comprise (voir Chopra 1933 : 281), ont été établies d'après un seul spécimen. Pour *E. modestus* et *E. brocki*, peu de matériel a été étudié après la description originale pour les autres, seuls le ou les types sont connus jusqu'à présent.

Ce travail ne fait pas exception et les trois espèces décrites ici sont représentées chacune par un seul spécimen. Deux d'entre elles ont été récoltées en Polynésie française, ce sont : *Eutrichocheles brocki* (de Man) et *Eutrichocheles tuamotu* n.sp. ; la troisième, *Eutrichocheles crosnieri* n.sp. provient du Vietnam. Toutes les trois sont comparées aux espèces voisines et l'espèce-type du genre, *E. modestus*, qui est proche de celle du Vietnam, est revue plus en détail, avec sa diagnose.

Les spécimens étudiés font partie des collections du Natural History Museum, London (BM), du Muséum national d'Histoire naturelle, Paris (MNHN), de la Zoological Reference Collection, University of Singapore (ZRC). Les mensurations indiquées dans les descriptions concernent la longueur de la carapace, rostre inclus (lc.) et la longueur totale (lt.), rostre et telson inclus.

Genre *Eutrichocheles* Wood Mason, 1876

Eutrichocheles Wood Mason, 1876 : 231. – Chopra 1933 : 277. – Balss 1957 : 1580. – Sakai & de Saint Laurent 1989 : 51. – Sakai 1994 : 185. – Poore 1994 : 97 (clé).

Axiopsis (*Paraxiopsis*) de Man, 1905 : 597 ; 1925 : 71, 101. – Gurney 1942 : 240.

Diagnose

(adaptée de Sakai & de Saint Laurent 1989 et Sakai 1994).

Région antéro-dorsale de la carapace (ou gastrique) convexe dans sa partie médiane, avec une paire de carènes latérales, une paire de carènes submédianes et une carène médiane ; sillon cervical bien défini, bord antéro-latéral de la carapace avec une ou deux épines. Rostre triangulaire, à bout pointu dépassant les yeux ; bords latéraux dentés se continuant postérieurement par les carènes latérales de la carapace. Telson plus long que large, face dorsale avec une paire de carènes obliques, bord postérieur souvent avec une épine médiane. Yeux globuleux ou cylindriques, cornées plus ou moins pigmentées. Deuxième segment du pédoncule antennaire avec une petite dent dorso-distale, écaille antennaire bifurquée ou trifurquée. Péréiopodes 1 subégaux, péréiopodes 3 et 4 (quelquefois) au propode muni de rangées tranversales d'épines. Épipodites présents aux maxillipèdes 1-3 et péréiopodes 1-4 ; une paire d'arthrobranchies aux maxillipèdes 3 et péréiopodes 1-4. Pléopode 1 mâle absent ou présent en un très petit lobe arrondi ou allongé, sans flagellum, pléopode 2 mâle avec *appendix masculina*, pléopodes 2-5 mâle sans *appendix interna* ; pléopode 1 femelle présent, uniramé, avec un article basal et un flagellum multiarticulé, ou absent (rare), pléopodes 2-5 femelle sans *appendix interna*. Exopodite des uropodes avec une suture transverse.

Remarques

Le genre *Eutrichocheles* est jusqu'à présent caractérisé, entre autres, par un bord antéro-latéral de la carapace souvent muni d'une épine et une écaille antennaire bifurquée. Sa diagnose a été modifiée à ce niveau car, comme chez *E. brocki* (voir de Man 1925 : 103, 107), le bord antéro-latéral de la carapace est muni de deux épines

chez l'espèce nouvelle du Vietnam ; de plus, son écaille antennaire est trifurquée. Dans le genre *Eutrichocheles* comme chez certains autres membres des Axiidae, chaque bord latéral denté du rostre se continue postérieurement dans la région gastrique par une carène latérale qui est, elle aussi, munie de dents. Pour la clarté de la description, il est parfois nécessaire de différencier les dents rostrales de celles des carènes. Dans ce travail, cette différentiation se fait par le bord postérieur de la cavité orbitaire. En vue dorsale et surtout en vue latérale de la région gastrique, les dents qui sont placées au-delà de ce bord sont considérées comme appartenant au rostre, celles placées en arrière sont rattachées aux carènes.

Poore (1994 : 97), dans la clé des genres d'Axiidae, considère les *Eutrichocheles* comme dépourvus d'*appendix interna* aux pléopodes 2-5. Pour plus de précisions, il faudrait ajouter que, chez le mâle, un *appendix masculina* est présent au pléopode 2. Sakai (1994) suggère de revoir les caractéristiques des pléopodes dans le genre *Eutrichocheles*. Celles indiquées dans la diagnose ci-dessus proviennent de l'étude du matériel présent et d'autres spécimens du même genre dans les collections du Muséum national d'Histoire naturelle, Paris.

Eutrichocheles brocki (De Man, 1888)
(Fig. 1)

Axius Brocki de Man, 1888 : 475, pl. 20, fig. 3.

Axiopsis (Paraxiopsis) Brocki de Man, 1905 : 597 ; 1925 : 71, 101, pl. 8, fig. 19-19f.

Axiopsis (Paraxiopsis) brocki – Poore & Griffin 1979 : 228, fig. 3. – Sakai 1987 : 304.

Eutrichocheles brocki – Sakai & de Saint-Laurent 1989 : 52, fig. 4B. – Sakai 1992a : 215, 1994 : 185.

Eutrichocheles aff. *brocki* – Sakai 1992b : 169.

MATERIEL EXAMINÉ. — **Polynésie française.** Archipel de Tuamotu, atoll de Fangataufa, fond de corail et de sable, avril 1997, coll. Gilbert Poli : 1 ♀, lc. 6,5 mm, lt. 17,5 mm (MNHN-Th 1313).

LOCALITÉ-TYPE. — Ambone, Indonésie.

DISTRIBUTION. — Indonésie, Bornéo, Okinawa, Japon, Polynésie, Australie septentrionale et occidentale. Fonds rocheux ou de corail, jusqu'à 84 m.

DIAGNOSE

Bord antéro-latéral de la carapace avec deux épines. Rostre triangulaire, bord latéral avec une ou deux dents. Carène latérale de la région gastrique munie de deux dents dans le tiers antérieur ; carènes submédianes, continues ou interrompues en leur milieu, avec une dent antérieure terminale ; carène médiane avec une protubérance au tiers postérieur. Pédoncule oculaire court, ne dépassant pas le milieu du rostre. Écaille antennaire bifurquée distalement, troisième segment du pédoncule antennaire avec deux ou trois spinules ventrales. Maxillipède 3 avec trois ou quatre fortes épines ventrales au mérus, une épine ventro-subdistale au carpe. Péréiopode 1 avec une épine dorsale au tiers antérieur du mérus, propode muni d'une carène longitudinale dorsale se terminant par une épine subdistale et une faible carène ventrale tuberculée. Péréiopode 2 avec une épine ventro-distale au mérus, une épine vers le milieu du bord ventral et une à quatre épines dans la moitié proximale. Telson plus long que large, carène oblique munie de trois ou quatre épines, bord latéral avec trois à cinq épines, bord postérieur convexe, épine médiane présente.

DESCRIPTION

Carapace lisse, à sillon cervical bien défini ; bord antéro-latéral avec une épine près du bord supérieur du pédoncule antennaire en vue latérale, et une autre beaucoup plus petite placée plus bas ; région gastrique bombée en arrière du rostre. Rostre (Fig. 1B) à peu près triangulaire, se terminant en pointe vers le milieu du deuxième segment antennulaire, face dorsale légèrement concave, bord latéral armé d'une petite dent et de deux tubercules à droite, de deux dents et de deux tubercules à gauche. Carène latérale, en continuation avec le bord latéral du rostre, munie de deux dents antérieures, l'une en arrière des yeux, l'autre vers le tiers antérieur, le reste inerme ; carène submédiane inerme, à l'exception d'une dent antérieure terminale ; carène médiane inerme elle aussi, à part d'une petite protubérance au tiers postérieur.

Abdomen lisse (Fig. 1A) à pleurons arrondis, celui du deuxième segment recouvrant légèrement ceux du premier et du troisième. Telson

(Fig. 1E) environ 1,2 fois plus long que large, face dorsale avec un faible sillon médian longitudinal dans la moitié postérieure et quatre épines le long de chaque carène oblique dont la plus distale est mobile ; bord latéral armé de quatre épines ; bord postérieur faiblement convexe, avec une spinule médiane.

Pédoncule oculaire court (Fig. 1B), ne dépassant pas le milieu du rostre, cornée globuleuse, bien pigmentée. Premier segment du pédoncule antennulaire (Fig. 1H) muni d'une spinule latérale et, à la face dorsale, d'une fente elliptique recouverte de soies communiquant avec la cavité du statocyste ; deuxième segment légèrement plus long que le dernier. Deuxième segment du pédoncule antennaire (Fig. 1I) avec une épine disto-latérale, écaille antennaire bifurquée distalement ; troisième segment avec une épine distoventrale et deux spinules ; quatrième segment à peu près aussi long que le deuxième et 1,5 fois plus long que le cinquième.

Maxillipède 3 (Fig. 1F) avec une épine au bord ventral de la coxa et du basis ; ischion avec quatre spinules ventrales et une forte *crista dentata* munie de dix dents et de quatre tubercules à la face interne (Fig. 1G) ; mérus armé d'un tubercule et de quatre épines au bord ventral, ces dernières de taille croissante de l'arrière vers l'avant ; carpe plus court que le mérus avec une épine ventro-subdistale ; propode presque aussi long que le carpe et plus long que le dactyle ; exopodite ne dépassant pas en longueur le bord distal du mérus, composé d'un article basal et d'un flagellum mutiarticulé.

Péréiopodes 1 (Fig. 1C) grêles, subégaux. Ischion et mérus à bord ventral serrulé, muni d'une ou de deux épines à l'ischion et de trois ou quatre épines au mérus ; carpe inerme ; propode environ deux fois plus long que large, avec deux fines carènes longitudinales, une dorsale se terminant en une épine distale, et une ventrale faiblement tuberculée ; doigt fixe et dactyle, environ deux tiers aussi longs que le propode, à extrémité recourbée ; bord sécant avec une protubérance triangulaire au tiers proximal et des dents arrondies dans les deux tiers distaux, ces dernières étant plus faibles sur le dactyle. Mérus du péréiopode 2 (Fig. 1D) avec une spinule ventro-distale, une autre au quart proximal et une épine plus forte vers le milieu du bord ventral ; doigt fixe et dactyle, environ à moitié aussi long que le propode, à bord sécant faiblement pectiné. Quatrième sternite thoracique avec la partie postérieure concave munie d'une fente médiane longitudinale et, de chaque côté, d'une épine antéro-latérale.

Orifices génitaux femelles bien ouverts sur les coxae des péréiopodes 3.

Pléopode 1 uniramé, petit, comprenant un basipodite et un flagellum multiarticulé à peu près de même longueur. Pléopodes 2-5 (Fig. 1J) semblables, à exopode et endopode grêles, sans *appendix interna*.

Exopode des uropodes armé respectivement de quatre et de trois épines au bord latéral externe et à la crête latérale externe ; endopode avec respectivement trois et cinq épines au bord latéral externe et à la crête médiane.

REMARQUES

La jeune femelle examinée s'accorde bien avec la description de l'espèce (de Man 1888, 1925). La région antérieure de la carapace, la morphologie et spinulation des antennule et antenne, des péréiopodes 1 et 2 sont comparables à celles de la femelle ovigère, de 20,5 mm de longueur totale, récoltée à Borneo Bank (de Man 1925, pl. 8, fig. 19). Elle présente toutefois les variations suivantes : (1) carènes submédianes non interrompues en leur milieu. Cette différence a déjà été signalée chez d'autre matériel étudié par de Man (1925 : 104) ainsi que par Poore & Griffin (1979 : 228) dans le matériel d'*E. brocki* d'Australie ; (2) péréiopode 1 avec une protubérance triangulaire sur le doigt fixe et le dactyle ; par ce caractère, ce spécimen polynésien se rapproche du matériel australien (Poore & Griffin 1979, fig. 3d) ; (3) telson subquadrangulaire, plus court que chez le matériel étudié par de Man (1888, pl. 20, fig. 3c ; 1925, pl. 8, fig. 19f) ainsi que chez celui d'Australie (Poore & Griffin 1979, fig. 3c) ; (4) la convexité du bord postérieur est approximativement la même chez le spécimen polynésien et l'une des femelles ovigères types (de Man, 1888, fig. 3c), mais plus faible que chez le matériel d'Australie (Poore & Griffin 1979, fig. 3c) ainsi que chez une femelle ovigère de la *Siboga* (de Man 1925, fig. 19f).

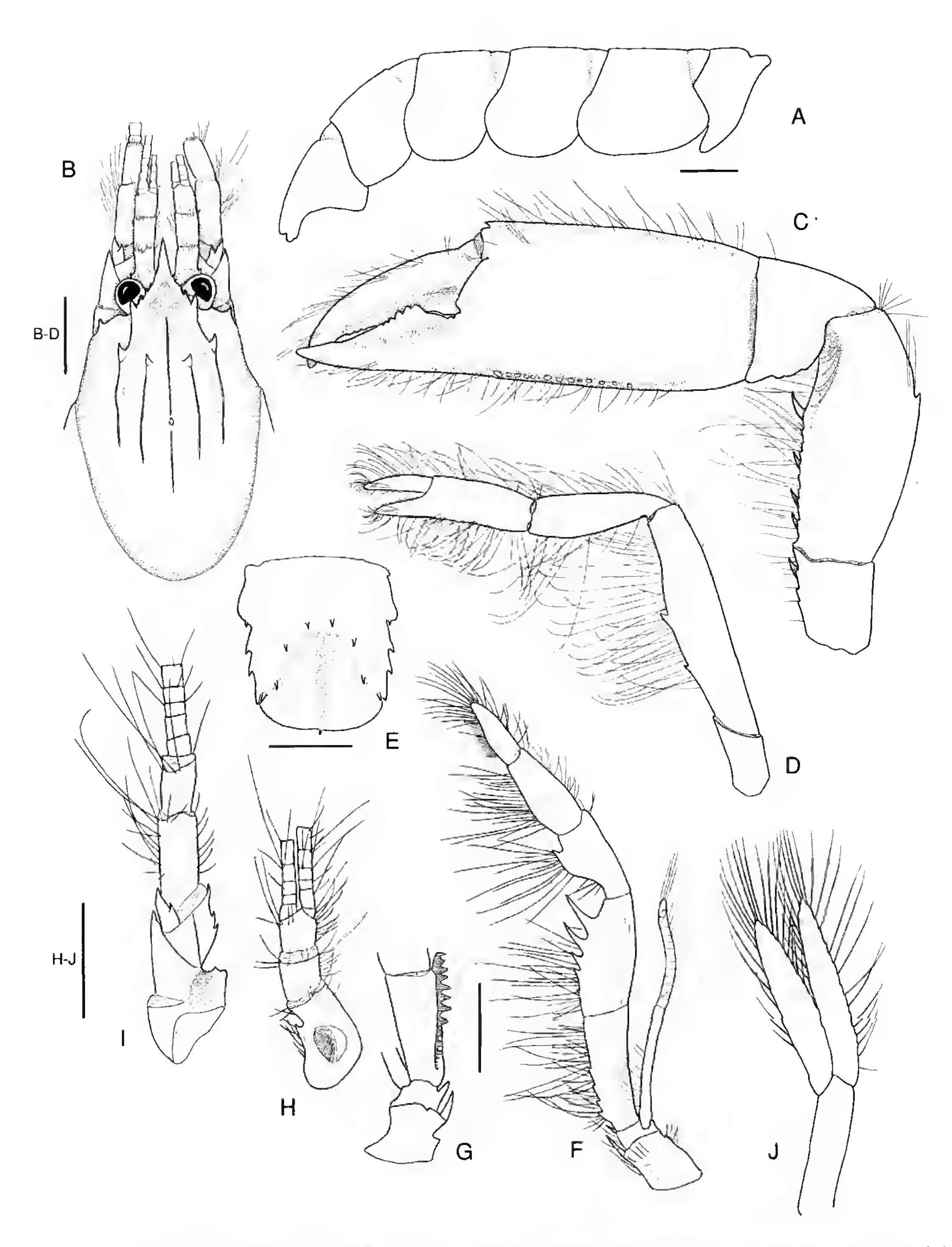


FIG. 1. — *Eutrichocheles brocki* (de Man), ♀ (MNHN-Th 1313) ; **A**, abdomen, vue latérale ; **B**, région gastrique, vue dorsale ; **C**, **D**, péréiopodes 1 et 2 respectivement, vue externe ; **E**, telson, vue dorsale ; **F**, **G**, respectivement maxillipède 3, vue externe et les trois segments proximaux, vue interne ; **H**, **I**, antennule et antenne respectivement, vue dorso-ventrale ; **J**, pléopode 2, vue externe. Échelles : 1 mm.

Comparé au spécimen examiné ici (lc: 6,5 mm), ceux étudiés par Poore et Griffin (lc. 13-17 mm) sont de plus grande taille et diffèrent aussi par : (1) un rostre plus étroit (fig. 3a) ; (2) des épines rostrales plus fortes ainsi que celles du telson (fig. 3c) ; (3) l'absence de carènes longitudinales dorsale et ventrale au propode du péréiopode 1.

Eutrichocheles tuamotu n.sp.
(Figs 2, 3)

MATÉRIEL-TYPE. — **Polynésie française.** Archipel de Tuamotu, Moruroa, stn 51, 21°53,12'S -139°2,62'W, dragage, 140 m, fond corallien dur, 15.X.1990, récoltes SMCB (J. Poupin) : holotype ♂, lc. 9 mm, lt. 21 mm (MNHN-Th 1315).

LOCALITÉ-TYPE. — Tuamotu (Polynésie française).

ÉTYMOLOGIE. — L'espèce est nommée d'après sa localité-type.

DIAGNOSE

Bord antéro-latéral de la carapace avec une épine. Rostre allongé, triangulaire, bord latéral avec deux dents et deux ou trois tubercules. Région gastrique de la carapace avec carène latérale courte munie d'une dent ; carène submédiane représentée par une rangée de six dents et trois ou quatre tubercules ; carène médiane avec une protubérance vers son milieu. Pédoncule oculaire court, ne dépassant pas le tiers du rostre. Écaille antennaire bifurquée distalement, troisième segment du pédoncule antennaire avec trois spinules ventrales. Maxillipède 3 avec une spinule et deux grandes épines ventrales au mérus, carpe avec une épine ventro-distale. Péréiopodes 1 subégaux, mérus avec une ou deux épines dorsales au tiers antérieur, propode avec des tubercules dorsaux et une épine dorso-subdistale. Péréiopodes 2 avec de grosses soies cornées au bord ventro-distal du mérus. Pléopode 1 mâle présent, très petit. Telson plus long que large, bord latéral avec cinq épines, carène oblique avec trois épines, bord postérieur convexe, épine médiane présente.

DESCRIPTION

Carapace lisse (Fig. 3A), à sillon cervical bien défini, bord antéro-latéral (Fig. 2) avec une épine, région gastrique bombée en arrière du rostre. Rostre triangulaire allongé, se terminant en pointe vers le milieu du dernier segment antenulaire ; face dorsale faiblement concave, bord latéral armé de deux épines au niveau des yeux et, un peu plus en avant, de deux tubercules à gauche, d'un tubercule à droite. Carène latérale, en continuation avec le bord latéral du rostre, avec une partie carénée armée d'une forte dent vers son milieu et suivie en arrière par trois tubercules ; carène submédiane représentée par une rangée de six dents et trois ou quatre tubercules ; carène médiane bien définie, s'étendant de la base du rostre jusqu'au quart postérieur environ de la région gastrique, munie d'une petite protubérance vers son milieu.

Abdomen lisse (Fig. 2), pleuron du deuxième segment le plus large, recouvrant en partie ceux du premier et du troisième. Telson (Fig. 3B) environ 1,4 fois plus long que large, face dorsale avec un faible sillon médian longitudinal dans sa par-

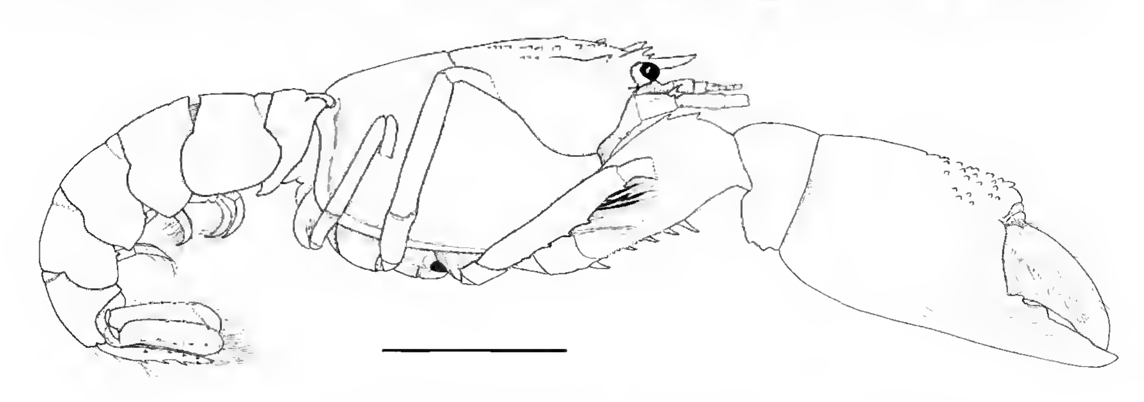


FIG. 2. — *Eutrichocheles tuamotu* n.sp., holotype, ♂ (MNHN-Th 1315), vue latérale. Échelle : 4 mm.

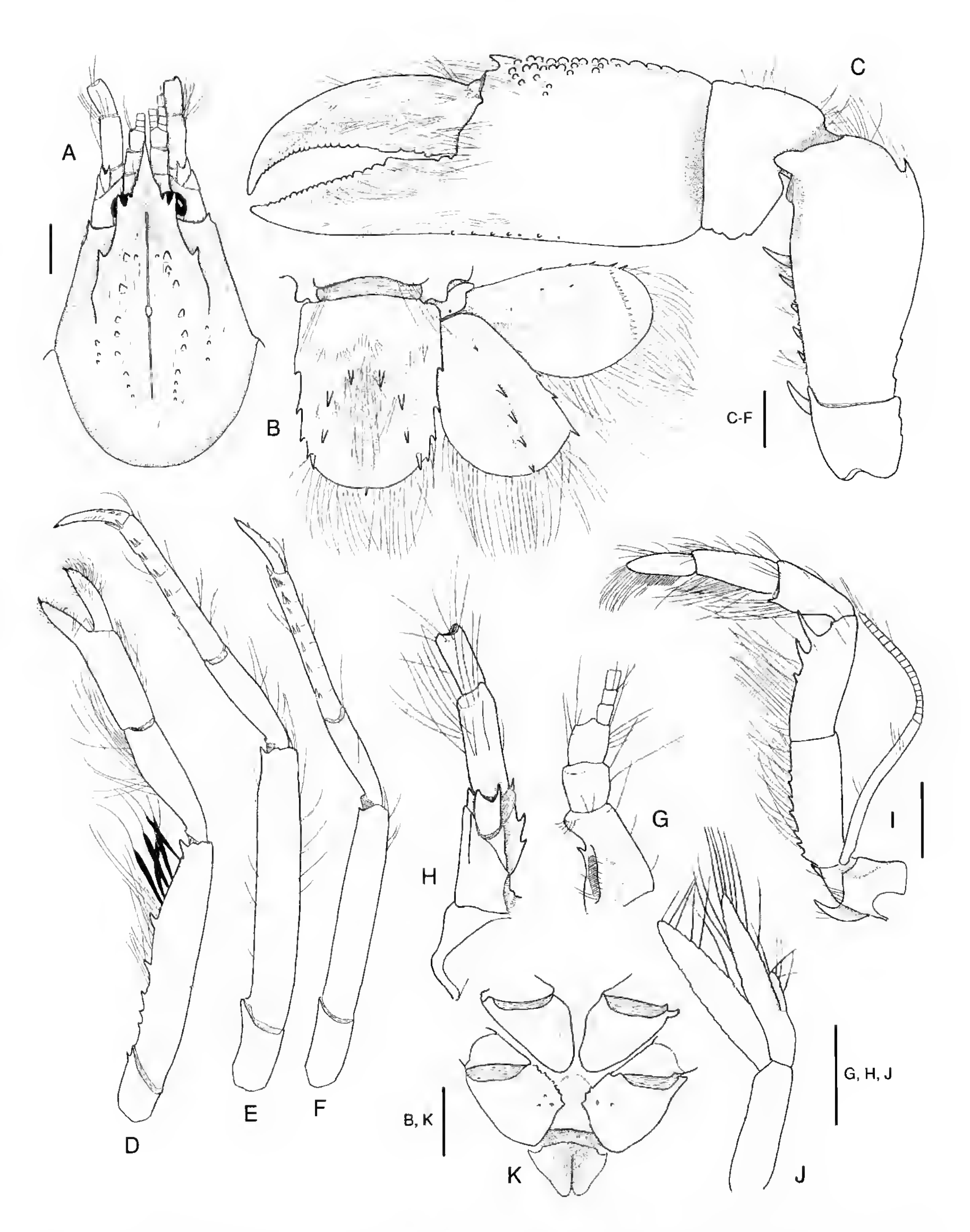


FIG. 3. — *Eutrichocheles tuamotu* n.sp., holotype, ♂ (MNHN-Th 1315) ; **A**, région gastrique, vue dorsale ; **B**, telson et uropodes, vue dorsale ; **C-F**, péréiopodes 1, 2, 3 et 4 respectivement, vue externe ; **G**, **H**, antennule et antenne respectivement, vue dorso-ventrale ; **I**, maxillipède 3, vue externe ; **J**, plèopode 2, vue externe ; **K**, quatrième sternite abdominal, vue ventrale. Échelles : 1 mm.

tie postérieure et quatre épines le long de chaque carène oblique dont la plus distale est mobile ; bord latéral armé de quatre épines plus petites ; bord postérieur arrondi muni d'une spinule médiane.

Pédoncule oculaire (Fig. 3A) très court, atteignant à peine le tiers du rostre, cornée globuleuse, bien pigmentée. Premier segment du pédoncule antennulaire (Fig. 3G), environ deux fois plus long que le deuxième, avec une spinule dorso-latérale subdistale et, à sa face dorsale, une fente elliptique recouverte de soies communiquant avec la cavité du statocyste ; deuxième et troisième segments à peu près de même longueur, inermes. Deuxième segment du pédoncule antennaire (Fig. 3H) muni d'une épine disto-latérale ; écaille antennaire bifurquée distalement ; troisième segment avec une épine ventro-distale et deux spinules ventrales ; quatrième segment environ 1,5 fois plus long que le cinquième, tous deux inermes.

Maxillipède 3 (Fig. 3I) avec une forte épine ventrale sur la coxa, une épine plus petite sur le basis ; ischion avec sept spinules ventrales et, à la face interne, une forte *crista dentata* munie de quatorze dents de taille croissante de l'arrière vers l'avant ; mérus armé d'une spinule et de deux grandes épines dans la moitié distale du bord ventral ; carpe avec une épine ventro-distale ; propode presque aussi long que le carpe et 1,5 fois plus long que le dactyle, tous deux inermes. Exopodite atteignant par son extrémité le milieu du carpe, avec un article basal et un flagellum multiarticulé.

Péréiopodes 1 (Figs 2, 3C) subégaux, le droit étant plus robuste. Ischion avec une forte épine ventrale ; mérus à bord ventral serrulé portant quatre à cinq épines de taille croissante d'arrière en avant et une ou deux épines au tiers distal du bord dorsal ; bord ventral du carpe dentelé ; propode environ 1,5 fois plus long que large au péréiopode gauche, plus court à droite, bords dorsal et dorso-externe munis de tubercules ronds et d'une épine dorso-subdistale ; doigt fixe et dactyle à peu près aussi longs que le propode au péréiopode gauche et deux tiers aussi longs à droite ; bord sécant du doigt fixe muni d'une dent plate au tiers proximal et de petites dents arrondies dans la partie distale au péréiopode gauche, avec deux dents triangulaires dans le tiers proximal et lisse dans la partie distale au péréiopode droit ; dactyle à extrémité recourbée, bord sécant armé de dents arrondies plus ou moins grandes au péréiopode gauche, inerme à droite. Péréiopode 2 (Fig. 3D) avec une spinule ventrale sur l'ischion ; mérus pourvu de quatre ou cinq épines dans les deux tiers proximaux du bord ventral, quatre ou cinq grosses soies cornées dans le tiers distal et une épine ventro-distale ; carpe et propode inermes ; doigt fixe et dactyle légèrement plus courts que le propode, se terminant en de petits ongles cornés. Péréiopodes 3 et 4 (Fig. 3E, F) très semblables sauf une plus grande taille au péréiopode 3 ; mérus avec une épine ou spinule ventro-distale ; propode muni de soies cornées spiniformes disposées plus ou moins en rangées transversales, dactyle se terminant en un ongle corné. Quatrième sternite thoracique (Fig. 3K) composé d'une partie antérieure mal délimitée latéralement et d'une partie postérieure avec une fente médiane longitudinale et, de chaque côté, une épine antéro-latérale.

Orifices génitaux mâles petits et peu visibles sur les coxae des péréiopodes 5.

Pléopode 1 présent comme un très petit lobe ovale. Pléopode 2 (Fig. 3J) avec exopode et endopode grêles, *appendix masculina* présent. Pléopode 3-5 dépourvus d'*appendix interna*.

Uropode (Fig. 3B) avec exopode à bord postérieur arrondi, avec cinq spinules au bord latéral externe ; endopode pourvu de quatre épines au bord latéral externe et de cinq autres plus fortes sur la crête médiane.

REMARQUES

Eutrichocheles tuamotu est comparable à l'espèce australienne, *E. austrinus* Sakai, 1994 dont le matériel-type est constitué de deux femelles. Ces dernières, le paratype et l'holotype, ont été récoltées à Darwin, Australie, respectivement le 1er janvier 1983 et le 30 janvier 1983, le paratype sous un rocher intertidal et l'holotype lui aussi probablement en eau peu profonde (Sakai comm. pers.), bien que l'endroit de récolte ne soit pas précisément indiqué.

Le mâle du nouveau taxon ressemble aux types de l'espèce de Sakai par la présence d'une épine sur le bord antéro-latéral de la carapace, par la

forme et la spinulation du rostre ainsi que celles du telson et des uropodes. Toutefois, en dehors de celles des péréiopodes 1 considérées comme liées au sexe, plusieurs différences les séparent : (1) rostre plus long, extrémité atteignant le milieu du dernier segment antennulaire chez *E. tuamotu* (plus court, extrémité atteignant à peine le milieu du deuxième segment antennulaire chez *E. austrinus*) ; (2) carène latérale avec une seule forte dent sur la partie carénée chez *E. tuamotu* (deux fortes dents sur la partie carénée chez *E. austrinus*) ; (3) carène submédiane représentée par une rangée de six dents et de trois ou quatre tubercules chez *E. tuamotu* (une rangée de cinq dents chez *E. austrinus*) ; (4) pédoncule oculaire court, atteignant à peine le tiers du rostre chez *E. tuamotu* (plus long, atteignant les deux tiers du rostre chez *E. austrinus*) ; (5) maxillipède 3 avec sept spinules sur l'ischion, une spinule et deux épines sur le mérus chez *E. tuamotu* (quatre spinules sur l'ischion, quatre spinules, trois épines sur le mérus chez *E. austrinus*) ; (6) mérus du péréiopode 2 muni de grosses soies cornées au quart distal du bord ventral chez *E. tuamotu* (soies absentes chez *E. austrinus*).

On peut finalement ajouter que le type du nouveau taxon a été récolté à 140 m de profondeur alors que ceux de *E. austrinus* provenaient probablement tous les deux des eaux littorales.

Eutrichocheles crosnieri n.sp.
(Figs 4-6)

MATÉRIEL-TYPE. — **Vietnam.** Ha-tien, environ 30 m, 22.VIII.1995, ramené par les pêcheurs, coll. N. Ngoc-Ho : holotype ♀, lc. 33 mm, lt. 83,5 mm (MNHN-Th 1314).

AUTRE MATÉRIEL EXAMINÉ. — *Eutrichocheles modestus* (Herbst) : **Malaisie.** Pinang, Dr Cantor coll. : ♂, lc. 30 mm, en mauvais état (BM 1879.32).
Singapore. Marché aux poissons, janvier 1914, Dr Falshawn coll. : ♂, cl. 29,5 mm, lt. 74 mm (MNHN-Th1267). — 18.IX.1914, V. Jacobs Esq. coll : ♂, lc. 38 mm, lt. 90 mm (ZRC 1992.10228). — Juin 1933, coll. inconnu : ♂, lc. 28 mm, lt. 69 mm (ZRC 1992.10232).

ÉTYMOLOGIE. — L'espèce est nommée en hommage à Alain Crosnier, biologiste de l'ORSTOM.

LOCALITÉ-TYPE. — Ha-tien (Vietnam).

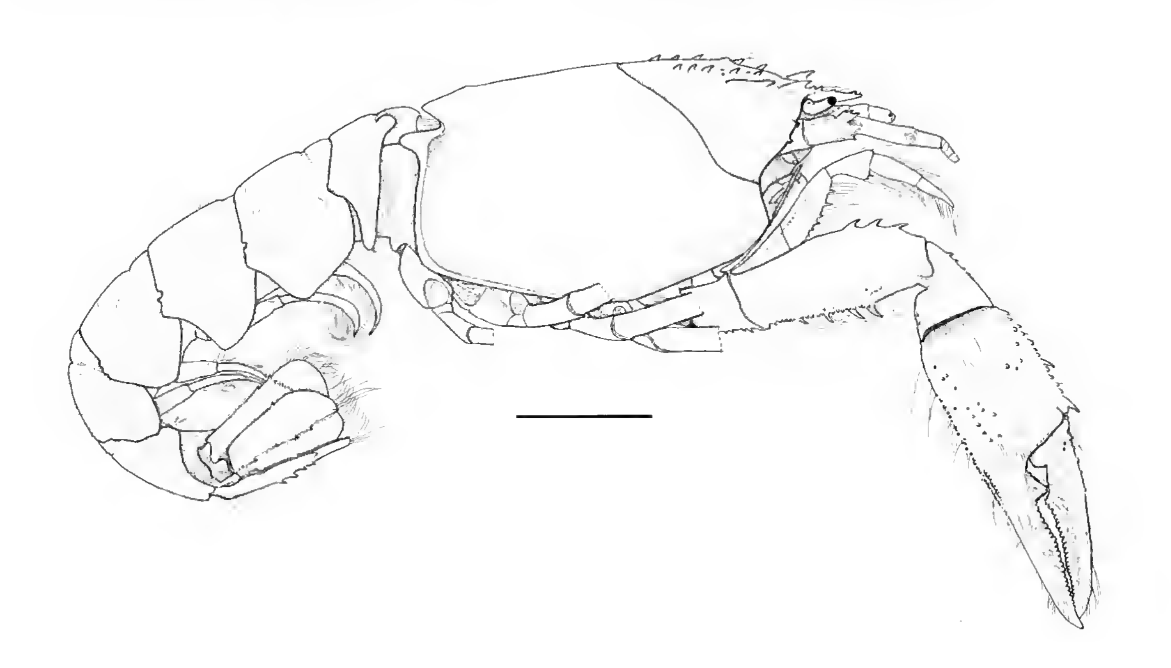


FIG. 4. — *Eutrichocheles crosnieri* n.sp., holotype, ♀ (MNHN-Th 1314), vue latérale. Échelle : 10 mm.

DIAGNOSE

Bord antéro-latéral de la carapace avec deux épines. Rostre styliforme, bord latéral avec quatre ou cinq dents. Carène latérale de la région gastrique courte, avec deux fortes dents antérieures ; carène submédiane représentée par six dents ; carène médiane avec une protubérance vers son milieu. Pédoncule oculaire moyennement long, atteignant le milieu du rostre. Écaille antennaire trifurquée distalement ; troisième segmenr du pédoncule antennaire avec une épine ventro-distale. Maxillipède 3 avec cinq spinules, quatre épines ventrales au mérus, carpe avec une épine ventro-distale. Péréiopodes 1 subégaux, mérus avec une faible carène longitudinale dorsale et trois épines dorsales ; propode court avec deux épines dorsales, doigt fixe avec une grosse dent triangulaire proximale ; dactyle et doigt fixe non arqués. Quatrième sternite abdominal avec partie postérieure munie d'une fente médiane, bord latéral inerme. Telson plus long que large avec un sillon médian longitudinal dans sa partie postérieure, carène oblique et bord latéral avec quatre ou cinq épines, bord postérieur convexe avec une échancrure médiane munie d'une petite épine.

DESCRIPTION

Carapace munie de fins tubercules (Fig. 4), à sillon cervical bien défini, bord antéro-latéral avec deux épines, la plus ventrale étant plus petite. Rostre styliforme (Fig. 5A), extrémité cassée (une petite partie terminale manquante), face dorsale légèrement concave, bord latéral armé de quatre ou cinq dents. Région gastrique bombée en arrière du rostre. Carène latérale, en continuité avec le bord latéral du rostre et s'étendant jusqu'au milieu environ de la région gastrique, avec deux fortes dents séparées par de petits tubercules, la première juste en arrière des yeux, la deuxième vers son milieu ; carène submédiane représentée par une rangée de six fortes dents s'étendant jusqu'au quart postérieur de la région gastrique ; carène médiane partant de la base du rostre et occupant les deux tiers environ de la région gastrique, avec une petite protubérance vers son milieu.

Abdomen (Fig. 4) muni de petites soies dorsales, à pleurons tronqués ventralement, celui du deuxième segment à peine plus large que les autres et recouvrant à peine ceux du premier et du troisième. Telson (Fig. 5B) environ 1.3 fois plus long que large, légèrement bombé dorsalement, avec un sillon médian longitudinal dans sa partie postérieure, quatre ou cinq épines le long des carènes obliques dont la plus distale est mobile ; bord latéral avec un renflement dans la moitié proximale muni d'une épine, trois ou quatre épines dans la moitié distale ; bord postérieur arrondi avec une petite encoche médiane armée d'une épine.

Pédoncule oculaire (Fig. 5A) cylindrique, moyennement long, atteignant le milieu du rostre, cornée globuleuse, faiblement pigmentée. Premier segment du pédoncule antennulaire (Fig. 6A) à peu près aussi long que les deuxième et troisième réunis, muni à la face dorsale d'une fente elliptique recouverte de soies communiquant avec la cavité du statocyste ; deuxième et troisième segments approximativement de même longueur, tous trois inermes. Deuxième segment du pédoncule antennaire (Figs 5A, 6B) avec écaille antennaire trifurquée distalement ; troisième segment (Figs 4, 6B) avec une épine ventro-distale ; quatrième segment environ 1.5 fois plus long que le cinquième, tous deux inermes.

Maxillipède 3 (Fig. 5C) avec une forte épine ventro-distale sur la coxa, une épine plus petite sur le basis ; ischion muni de six spinules ventrales et, à la face interne, d'une forte *crista dentata* avec seize dents de taille croissante de l'arrière vers l'avant et dont les quatre proximales sont très petites ; mérus aussi long que l'ischion avec cinq spinules proximales et quatre épines distales au bord ventral, de taille croissante de l'arrière vers l'avant ; carpe avec une épine ventro-distale ; propode et dactyle inermes. Exopodite atteignant à peine par son extrémité le bord distal du mérus, composé d'un article basal et d'un flagellum multiarticulé.

Péréiopodes 1 (Fig. 4, 5D) subégaux, le droit étant légèrement plus robuste. Ischion et mérus au bord ventral serrulé ; ischion avec une épine ventro-subdistale ; mérus muni de quatre ou six grandes épines ventrales de taille croissante de l'arrière vers l'avant, et d'une faible carène longitudinale dorsale tuberculée avec trois fortes épines dorsales dans la moitié distale ; carpe environ un tiers aussi long que le mérus, muni de

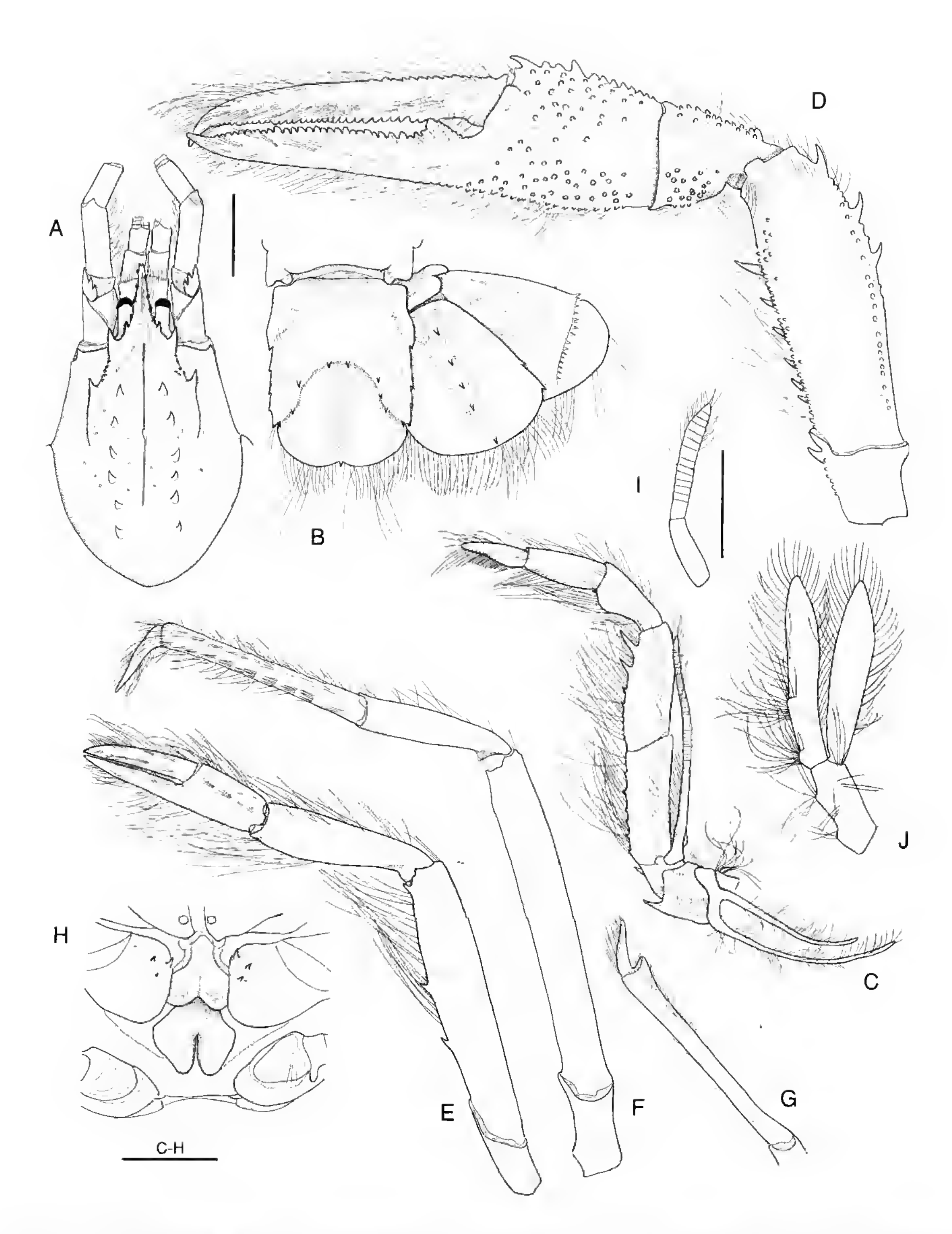


FIG. 5. — *Eutrichocheles crosnieri* n.sp., holotype, ♀ (MNHN-Th 1314) ; **A**, région gastrique, vue dorsale ; **B**, telson et uropodes, vue dorsale ; **C**, maxillipède 3, vue externe ; **D-G**, péréiopodes 1, 2, 3 et deux segments distaux du péréiopode 5 respectivement, vue externe ; **H**, quatrième sternite abdominal, vue ventrale ; **I**, **J**, pléopode 1 et 2 respectivement, vue externe. Échelles : A-H, J, 5 mm ; I, 2 mm.

nombreux tubercules et de quelques spinules sur toute sa surface, plus denses aux bords dorsal et ventral ; propode à peu près aussi long que large, recouvert de tubercules, plus proéminents au bord dorsal qui est pourvu de plus de deux épines dans sa moitié distale ; doigt fixe et dactyle non arqués et pratiquement parallèles entre eux, presque deux fois plus longs que le propode au péréiopode gauche, un peu plus court au péréiopode droit ; bord sécant du doigt fixe muni d'une forte dent triangulaire proximale et d'une rangée petites dents arrondies distales ; dactyle à extrémité incurvée, bord sécant muni de dents arrondies sauf dans le cinquième proximal. Péréiopodes 2 (Fig. 5E) mérus avec deux épines vers le tiers et les deux tiers du bord ventral et une épine ventro-distale. Péréiopodes 3 (Fig. 5F) et 4 très semblables, sauf une plus grande taille chez le premier ; propode avec des rangées transversales de soies cornées spiniformes. Péréiopode 5 (Fig. 5G) à extrémité légèrement subchéliforme. Quatrième sternite thoracique (Fig. 5H) composé d'une partie antérieure et d'une partie postérieure séparées par une forte lame transversale ; partie postérieure munie d'une fente médiane, bord latéral inerme.

Orifices génitaux femelles bien ouverts sur les coxae des péréiopodes 3.

Pléopode 1 femelle (Fig. 5I) avec un article basal et une partie terminale multiarticulée. Pléopodes 2-5 (Fig. 5J) exopodite et endopodite lancéolés, sans *appendix interna*.

Uropode (Fig. 5B) : exopodite lancéolé, avec deux épines au bord latéral ; endopodite presque quadrangulaire avec deux épines latérales et cinq ou six épines à la crête médiane.

À sa capture, la femelle holotype était de couleur jaune ocre ; par la suite, sa carapace a quelque peu blanchi dans l'alcool.

REMARQUES

Par la morphologie et la spinulation du rostre, du telson et des uropodes, le nouveau taxon apparaît très proche d'*Eutrichocheles modestus* (Herbst) et il semble nécessaire de présenter les principaux renseignements bibliographiques qui existent actuellement sur ce dernier, 200 ans après sa création.

La description originale détaillée de l'espèce (Herbst 1796) était accompagnée d'une figure en couleurs mais le sexe du type n'était pas indiqué. Il en était de même des deux travaux non illustrés qui suivaient sur *Axius biserratus* von Martens, ultérieurement mise en synonymie avec *Eutrichocheles modestus* (de Saint Laurent & Leloeuff 1979 : 32). Il s'agissait de la description originale très brève par von Martens (1868) sur deux spécimens-types du Muséum de Berlin, et d'un rapport détaillé par Nobili (1903) sur deux spécimens de Singapore. Plus tard, Chopra (1933) redécrivait *Eutrichocheles modestus* en se fondant sur le spécimen qui avait conduit Wood Mason à l'établissement du genre ; c'était le seul de ce nom à l'époque, déposé à l'Indian Museum (le type de Herbst ayant été perdu). Il précisa que le spécimen était une femelle et que les premiers pléopodes « *are very much reduced and are represented by short, uniramous, stumpy structures* ». Il y joignit une figure et deux photographies (pl. 6) qui montrèrent un spécimen aux péréiopodes 1 très semblables à ceux figurés par Herbst. Le plus récent travail en date sur l'espèce est celui, très court, de Balasubrahmanyan & Jacob (1961) sur deux spécimens (sexe non indiqué) récoltés par des pêcheurs à Porto Novo, Inde du Sud, avec une photographie sombre.

Quatre spécimens d'*E. modestus*, tous mâles (orifices génitaux femelles absents, orifices mâles petits sur les coxae des péréiopodes 5, *appendix masculina* aux pléopodes 2), ont été étudiés, l'un provenant de Malaisie (BM 1879. 32), les trois autres de Singapour (MNHN-Th1267, ZRC 1992.10228 et ZRC 1992. 10232). Ils ont tous des péréiopodes 1 robustes, semblables à ceux des spécimens d'Herbst et de Chopra ; le dactyle et le doigt fixe sont arqués, le doigt fixe est pourvu, au moins sur l'un des chélipèdes, d'une forte dent cylindrique proximale (Fig. 6C). Les pleurons abdominaux sont pointus ventralement et ceux des segments 3-5 armés d'une épine latéro-antérieure (Fig. 6D). Une courte carène médiane longitudinale (Fig. 6E) occupe le quart environ de la région dorso-postérieure de la carapace. Les pléopodes 1 sont présents, petits, sans flagellum (Fig. 6F) et pourraient être qualifiés de « *stumpy* » par Chopra.

L'examen de la littérature et du matériel d'*E. modestus* semble montrer qu'aucune femelle

de cette espèce n'a jamais été étudiée en détail et que les deux spécimens de Herbst et de Chopra étaient des mâles. Pour faciliter sa comparaison avec l'espèce du Viernam, une diagnose d'*E. modestus* est présentée ci-dessous :

Bord antéro-latéral de la carapace avec une épine ou une épine et un tubercule. Région dorso-postérieure de la carapace avec une courte carène médiane longitudinale. Rostre styliforme, bord latéral avec quatre à cinq dents proximales et un ou deux tubercules distaux. Carène latérale de la région gastrique courte, avec deux fortes dents antérieures ; carène submédiane avec six dents ; carène médiane avec une protubérance vers le tiers postérieur. Pédoncule oculaire atteignant le milieu du rostre. Écaille antennaire bifurquée distalement ; troisième segment du pédoncule antennaire avec une épine ventro-distale. Maxillipède 3 avec trois spinules et quatre épines ventrales au mérus, carpe avec une épine ventro-distale. Péréiopodes 1 égaux, mérus avec une

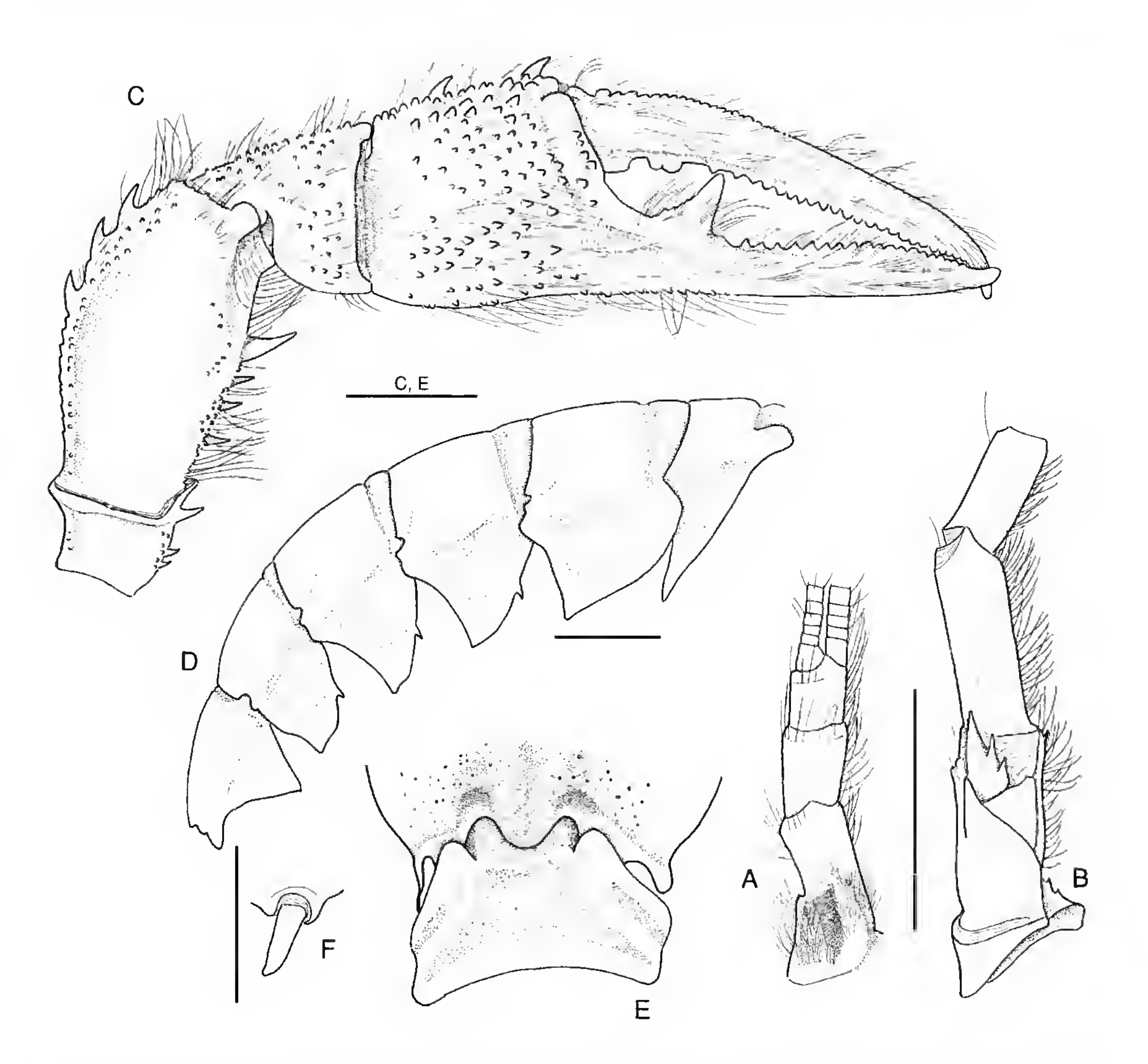


FIG. 6. — **A**, **B**, *Eutrichocheles crosnieri* n.sp., holotype, ♀ (MNHN-Th 1314), vue dorso-ventrale ; **A**, antennule ; **B**, antenne. **C**-**F**, *Eutrichocheles modestus* (Herbst), ♂ (MNHN-Th 1267) ; **C**, péréiopode 1, vue externe ; **D**, abdomen, vue latérale ; **E**, région postérieure de la carapace et premier segment abdominal, vue dorsale ; **F**, pléopode 1, vue ventrale. Échelles : A-E, 5 mm ; F, 2 mm.

faible carène longitudinale dorsale et deux à quatre épines dorsales ; propode court avec une ou deux épines dorsales, bord sécant du doigt fixe avec une grosse dent cylindrique proximale, au moins sur l'un des chélipèdes ; dactyle et doigt fixe arqués, le dactyle plus fortement. Quatrième sternite abdominal avec partie postérieure munie d'une fente médiane, bord latéral avec une forte épine antérieure. Pléopode 1 mâle présent, petit, allongé. Telson légèrement plus long que large avec un sillon médian longitudinal dans sa partie postérieure ; carène oblique et bord latéral chacun avec quatre ou cinq épines, bord postérieur convexe avec une échancrure médiane munie d'une petite épine.

La comparaison de la femelle holotype d'*E. crosnieri* et d'un mâle d'*E. modestus* révèle certaines différences qui peuvent être liées au sexe : (1) péréiopode 1 plus grêle, dactyle et doigt fixe non arqués, bord sécants munis de dents arrondies et d'une grosse dent triangulaire proximale au doigt fixe chez *E. crosnieri* (péréiopode 1 robuste, dactyle et doigt fixe aux bords sécants munis des dents triangulaires ; dactyle arqué, doigt fixe de l'un des péréopodes au moins muni d'une grosse dent cylindrique proximale chez *E. modestus*) ; (2) pleurons abdominaux obtus ventralement, inermes chez *E. crosnieri* (pleurons abdominaux pointus ventralement, ceux des segments 3-5 armés d'une épine latéro-antérieure chez *E. modestus*).

Les caractères suivants probablement non liés au sexe ont été utilisés pour différencier les deux espèces : (1) bord antéro-latéral de la carapace muni de deux épines chez *E. crosnieri* (une épine et un tubercule chez *E. modestus*) ; (2) région dorso-postérieure de la carapace pratiquement dépourvue de carène chez *E. crosnieri* (avec une courte carène médiane longitudinale chez *E. modestus*) ; (3) écaille antennaire trifurquée chez *E. crosnieri* (bifurquée chez *E. modestus*) ; (4) bord postéro-latéral du quatrième sternite abdominal inerme chez *E. crosnieri* (armé d'une forte épine chez *E. modestus*).

D'après Herbst, le type d'*E. modestus* était blanc avec des bandes rouges, et c'était un très joli spécimen. L'holotype d'*E. crosnieri*, dès sa capture, était de couleur jaune ocre, et apparemment sans beauté particulière.

DISCUSSION

L'établissement d'espèces nouvelles sur un seul spécimen-type comporte des incertitudes, surtout quand les taxons voisins ne sont connus que par des spécimens de sexe opposé. L'importance du dimorphisme sexuel ne pouvant pas être prise en considération, la différenciation a été principalement réalisée sur des caractères non liés au sexe. Un doute persiste toutefois jusqu'à ce qu'un supplément de matériel soit disponible.

Par la morphologie de la région gastrique se distingue d'abord, chez les espèces connues d'*Eutrichocheles*, un premier groupe comprenant celles dont les carènes submédianes sont soit absentes, soit présentes mais inermes ou munies d'une seule dent antérieure ; ce sont : *E. brocki* (de Man), *E. bisquamosa* (de Man), *E. pindatyba* Rodriguez *et* Kensley, *E. pumilus* Sakai, et probablement aussi *E. johnstoni* (Edmondson), car l'auteur n'a pas fait mention de carènes dans la description originale. Il s'agit d'espèces de petite taille (lt. 10-27 mm), au telson plus long que large et avec un bord postérieur plus ou moins arrondi. Dans le groupe d'espèces dont les carènes submédianes de la région gastrique sont munies de nombreuses dents figurent celles qui sont aussi de petite taille (lt. 20-28 mm) au bord postérieur du telson convexe ; ce sont : *E. defensus* (Rathbun), *E. austrinus* Sakai et *E. tuamotu* n.sp. Les deux espèces de taille nettement plus grande (lt. 80-90 mm) de ce groupe sont *E. modestus* (Herbst) et *E. crosnieri* n.sp. ; leur telson est plus long que large avec des carènes obliques bien marquées et un bord postérieur muni d'une encoche où se loge l'épine médiane. *E. crosnieri* se différencie en outre par la présence d'une écaille antennaire trifurquée.

Quelques renseignements écologiques sont connus pour certaines petites espèces d'*Eutrichocheles* dont la plupart ont été récoltées sur des fonds de coraux, de sable grossier ou de sable plus fin ; les profondeurs des localités varient de 0 à 140 m, l'espèce trouvée la plus profondément étant *E. tuamotu*. Seule l'espèce australienne, *E. pumilus* Sakai, a été signalée vivant dans une éponge. Par contre, en ce qui concerne les grandes espèces, l'unique détail sur l'habitat a été fourni par Balasubrahmanyan & Jacob (1961)

chez *E. modestus* : les deux spécimens étudiés ont été récoltés à Porto Novo, Inde du Sud, à 7-8 km de la côte et à une profondeur de 18 m. L'holotype d'*E. crosnieri* a été capturé à 30 m de profondeur environ par des pêcheurs, probablement au dragage.

Remerciements
L'auteur remercie le Natural History Museum, London (Miranda Lowe), l'University of Singapore (Peter NG), Gilbert Poli, Joseph Poupin qui ont fourni les spécimens d'*Eutrichocheles* examinés, et le Dr K. Sakai pour ses renseignements sur l'espèce *E. austrinus*. Elle adresse ses sincères remerciements à Pierre Noël qui a revu le manuscrit et à Gary Poore pour ses commentaires.

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Deep-water Arcturidae (Crustacea, Isopoda, Valvifera) from French collections in the south-western Pacific Ocean

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KEY WORDS
Crustacea,
Isopoda,
Valvifera,
Arcturidae,
Chaetarcturus,
Dolichiscus,
south-western Pacific Ocean,
systematics,
new species.

ABSTRACT
The arcturid genera *Chaetarcturus* Brandt, 1990 and *Dolichiscus* Richardson, 1913 are rediagnosed and six deep-water species recorded or described: *C. abyssicola* (Beddard, 1886) from north-eastern Australia; *C. crosnieri* n.sp. from the Coral Sea and New Caledonia, *C. taniae* n.sp. from New Caledonia, *D. cornutus* (Beddard, 1886) from Philippines, Indonesia and New Caledonia; and *D. kai* n.sp. and *D. tanimbar* n.sp. from Indonesia.

MOTS CLÉS
Crustacea,
Isopoda,
Valvifera,
Arcturidae,
Chaetarcturus,
Dolichiscus,
océan Pacifique SW,
systématique,
nouvelles espèces.

RÉSUMÉ
Arcturidae (Crustacea, Isopoda, Valvifera) de profondeur provenant des expéditions françaises dans le sud-ouest de l'océan Pacifique. Les genres d'Arcturidae *Chaetarcturus* Brandt, 1990 et *Dolichiscus* Richardson, 1913 sont redéfinis et six espèces de profondeur sont signalées ou décrites : *C. abyssicola* (Beddard, 1886) du nord-est d'Australie ; *C. crosnieri* n.sp. de la mer de Corail et de Nouvelle-Calédonie, *C. taniae* n.sp. de Nouvelle-Calédonie, *D. cornutus* (Beddard, 1886) des Philippines, d'Indonésie et de Nouvelle-Calédonie, et *D. kai* n.sp. et *D. tanimbar* n.sp. d'Indonésie.

INTRODUCTION

Deep-water marine collections made by French expeditions in the Philippines, Indonesia and New Caledonia between 1985 and 1994 include several species of valviferan isopod crustaceans of the family Arcturidae, most new to science. In this contribution six species belonging to two genera are reported or described. The genera, *Chaetarcturus* Brandt, 1990 and *Dolichiscus* Richardson, 1913 are rediagnosed. Both are diverse in Antarctic and deep-sea environments, so it is no surprise that they are the best represented of the genera in these collections. The French collections, largely placed in the Muséum national d'Histoire naturelle, Paris (MNHN), are supplemented by material collected by Australian expeditions in northern Australia, now deposited in the Museum Victoria (NMV).
Measurements of these strongly flexed animals are total lengths from the front of the head to the tip of the pleotelson along a line in the middle of the lateral surface. Illustrations of whole animals were made with a camera lucida and stereomicroscope. Scale bars on the figures are 10 mm and refer to habitus drawings only. The pereopods were drawn at the same scale after removal from the body and flattened to more accurately show relative lengths. The orientation of the legs is not therefore as they would appear in a whole animal. Mouthparts are not illustrated because there appears no difference in many characters across a wide range of arcturid taxa (see for example, Brandt 1990).

Family ARCTURIDAE Bate *et* Westwood, 1868

Genus *Chaetarcturus* Brandt, 1990

Chaetarcturus Brandt, 1990: 74-76; 1991: 151-153. – Wägele 1991: 117.

TYPE SPECIES. — *Chaetarcturus longispinosus* Brandt, 1990 (by original designation).

DIAGNOSIS

Body geniculate. Female pereonite 4 about as long as pereonites 2, 3. Pleonite 1 short, its suture with pleotelson vertical in lateral view. Pleotelson cylindrical. Paired pleotelsonic posterior spines present; with medial pleotelsonic posterior spine present. Mouthparts and pereopod 1 exposed in lateral view. Antenna 2 peduncle with few setae; flagellum of three to four articles. Pereopod 1 dactylus tapering, with unguis. Pereopods 2-4 dissimilar to pereopods 5-7, with rows of paired long setae. Pereopods 2-4 dactylus as long as propodus, with posterior row of setae. Pereopod 4 about as long as pereopod 3, of similar form. Pereopods 5-7 stout. Penes fused. Male pleopod 1 exopod thickened, laterally convex at midpoint, obliquely grooved, groove ending distolaterally on a subterminal angle. Oostegite 4 supported by ventral coxal process. Oostegite 5 absent in ovigerous female; incipient coxal processes not meeting in middle.

REMARKS

Chaetarcturus was diagnosed by Brandt (1990) principally on the basis of rows of long setae extending from the carpus and propodus on to the elongate dactylus of pereopods 2-4. The genus is unique among the *Antarcturus*-like genera in this feature. All others have long setae on the carpus to propodus and a reduced dactylus with few setae. The condition is an autapomorphy for the genus and, unlike some other character states, is not seen in other arcturids. Brandt (1991) used this character to differentiate *Chaetarcturus* from ten other genera in her cladogram of Arcturidae. A further autapomorphy is the configuration of the male pleopod 1. The pleopod 1 of the male is a critical diagnostic character in Arcturidae but has been rarely illustrated well. In *Chaetarcturus* the exopod is thickened, laterally convex at its midpoint, obliquely grooved, and with the groove ending distolaterally on a subterminal angle. The only other species of *Chaetarcturus* for which the male pleopod 1 has been illustrated is *C. aculeatus* (Kussakin, 1967) and it conforms with those of the two new species described here. Oostegites and their coxal support were introduced as significant characters for genera of Austrarcturellidae by Poore & Bardsley (1992). They are important for Arcturidae too and differentiate, for example, the *Antarcturus*-like genera (with four separate pairs of oostegites) from the *Astacilla*-group with

fewer oostegites. These groups were recognized on the basis of different character sets by Wägele (1989) and Brandt (1991).

Brandt (1990) and Wägele (1991) together listed seven Antarctic and seven Pacific species. Another one from the literature and *C. taniae* n.sp. are typical of the genus as conceived by Brandt. That is, in addition to the setose dactylus on pereopods 4-7, the species are generally spinose and possess a pair of posterior pleotelsonic spines. These sixteen species, with subspecies, are listed in table 1.

The last four species in table 1 differ from *C. longispinosus* Brandt, 1990, type species of *Chaetarcturus*. They lack strong dorsal spines and supraocular horns. All possess no or weak posterolateral diverging spines on the pleotelson. They possess a strong posteromedian spine on the pleotelson. The anterior margin of pereopod 5 is convex and tuberculate. All possess a setiform unguis on pereopods 2-4 (usually short in *Chaetarcturus*). Some of the species of *Chaetarcturus* listed by the two earlier authors share one or more of these characters. But because there is no character which uniquely separates the group from other members of *Chaetarcturus* it is difficult to justify a new genus for them. Nevertheless, all are from a very confined area of deep water of the south-eastern Pacific and may represent a monophyletic clade. None was included in *Chaetarcturus* by Brandt (1990).

Chaetarcturus abyssicola (Beddard, 1886)

Arcturus abyssicola Beddard, 1886a: 111; 1886b: 98-99, pl. 21 figs 5-8.

TABLE 1. — Species of the genus *Chaetarcturus* Brandt, 1990.

Species	Region	References
C. abyssalis (Birstein, 1963)	North-western Pacific Ocean	Kussakin 1982; Brandt 1990.
C. aculeatus (Kussakin, 1967)	Argentina; Marion-Prince Edward region	Kensley 1980; Brandt 1990; Wägele 1991.
C. acutispinis (Kussakin, 1982)	North-western Pacific Ocean	Brandt 1990.
C. adareanus (Hodgson, 1902)	Antarctica	Hodgson 1910; Hale 1937; Hale 1946; Brandt 1990; Wägele 1991.
C. bathybialis (Birstein, 1963)	North-western Pacific Ocean	Kussakin 1982; Brandt 1990.
C. beddardi (Gurjanova, 1935)	Sea of Okhotsk; north-western Pacific Ocean	Birstein 1963; Kussakin 1971, 1982; Brandt 1990.
C. bovinus (Brandt & Wägele, 1988)	Antarctica	Brandt 1990; Wägele 1991.
C. brunneus (Beddard, 1886a)	Kerguelen Islands	Beddard 1886b; Brandt 1990; Wägele 1991.
C. brunneus spinulosus (Nordenstam, 1933)	Shag Rock; South Georgia	Brandt 1990.
C. echinatus (Kussakin, 1982)	North-western Pacific Ocean.	
C. franklini (Hodgson, 1902)	Victoria Land; Adelie Land; Antarctic Peninsula; Falkland Islands; Graham Land	Hodgson 1910; Richardson 1913; Nordenstam 1933; Hale 1946; Kussakin 1967; Amar & Roman 1974; Kussakin & Vasina 1982; Brandt 1990; Wägele 1991.
C. globicaudis (Kussakin, 1982)	North-western Pacific Ocean.	
C. longispinosus Brandt, 1990	Antarctica, Shetland Islands	Wägele 1991; Pires & Sumida 1997.
C. oligospinis (Kussakin, 1971)	North-western Pacific Ocean	Kussakin 1982; Brandt 1990.
C. praecipius (Menzies *et* George, 1972)	Peru-Chile Trench	Brandt 1990.
C. taniae n.sp.	Coral Sea	
C. ultraabyssalis (Birstein, 1963)	North-western Pacific Ocean	Kussakin 1982; Brandt 1990.
C. abyssicola (Beddard, 1886)	Queensland, Australia	Beddard 1886a, b.
C. myops (Beddard, 1886)	North-eastern New Zealand	Beddard 1886a, b.
C. spinifrons (Beddard, 1886)	Fiji	Beddard 1886a, b.
C. crosnieri n.sp.	Coral Sea	

MATERIAL EXAMINED. — *Challenger* stn 184, 1400 fm (= 2550 m): 12 mm ♂ and 14 mm juvenile ♀ (BMNH 89.4.27.89 – labelled "holotype" incorrectly).

REMARKS

The holotype of this species, from *Challenger* station 281 (4300 m depth off southern Queensland, Australia), was said by Beddard (1886b) to be lacking an abdomen and is not at the Natural History Museum, London. But a male and female from station 184 (2500 m depth off Cape York, Australia; BMNH 1889.4.27.89) subsequently illustrated by Beddard (1886b) were examined. Both specimens are characteristic of the genus (narrow pleotelson with posterodorsal spine; setose dactyli on pereopods 2-4; elongate antennae 2 without row of long setae) and share with *C. crosnieri* similar body proportions, ornamentation and tuberculation on the basis of pereopod 5.

Chaetarcturus crosnieri n.sp.
(Figs 1, 2)

MATERIAL EXAMINED. — **Australia.** Queensland, Coral Sea, off Cairns, 17°12'S - 147°11'E, 13.V.1986, beam trawl, 1564 m, M. Pichon *et al.*: holotype, ♂, 28 mm (NMV J16513).
New Caledonia. BIOCAL stn CP23, 22°46'S - 166°20'E, 2040 m, 28.VIII.1985: paratype, ovigerous ♀, 18 mm (MNHN Is5070). — Stn CP26, 22°39.66'S - 166°26.37'E, 1618-1740 m, 28.VIII.1985: paratype, juvenile, 9.5 mm (MNHN Is5071). — Stn CP27, 26°06'S - 166°26'E, 1850-1900 m, 28.VIII.1985: paratype, juvenile ♀ with oostegites, 21 mm (MNHN Is5072). — Stn CP57, 23°44'S - 166°58'E, 1490-1620 m, 1.IX.1985: paratypes, ovigerous ♀, 16 mm; 2 juveniles, 9.3 and 12 mm (NMV J44029). — Stn CP58, 23°56.52'S - 166°40.55'E, 2660 m, 1.IX.1985: paratype, incomplete juvenile (MNHN Is5073). — Stn DS59, 23°56'S - 166°41'E, 2650 m, 2.IX.1985: paratype, ovigerous ♀, 26 mm (MNHN Is5074).
BIOGEOCAL stn CP272, 20°00.04'S - 166°56.94'S, 1615-1710 m, 19.IV.1987: paratype, damaged ♂, 15 mm (MNHN Is5075). — Stn CP317, 20°48.12'S - 166°53.16'E, 1630-1620 m, 2.V.1987: paratype, juvenile, 8.0 mm (MNHN Is5076).
Chesterfield Islands. MUSORSTOM 5 stn 323, 21°18.52'S - 157°57'E, 970 m, 14.X.1986: paratype, ovigerous ♀, 12 mm (MNHN Is5077).

DISTRIBUTION. — New Caledonia and north-eastern coast of Australia; 970-2660 m depth.

ETYMOLOGY. — For Alain Crosnier with thanks for making this material available, facilitating my study, and in recognition of his promotion of taxonomic research into marine crustaceans of the Pacific.

DESCRIPTION

Holotype

Head with scattered dorsal and dorsolateral tubercles and three more prominent lateral tubercles on marginal flange.

Pereonite 1 with three low transverse ridges, the most posterior with minute tubercles. Pereonites 2 and 3 each with two transverse ridges, minutely tuberculate; lateral margin swollen and minutely tuberculate. Pereonite 4 similar to pereonite 3, lateral swelling less pronounced.

Pereonites 5-7 with transverse ridge minutely tuberculate.

Pleonite 1 minutely tuberculate, with ventrally directed lateral spine. Pleonites 2-5 and telson fused, areas of pleonites 2 and 3 distinguishable from remainder by ventrolateral notches. Pleonite 2 slightly articulating with pleonite 1, minutely tuberculate. Pleonite 3 minutely tuberculate, with pair of lateral triangular projections. Remaining pleotelson minutely tuberculate, with obtuse lateral triangular projections near apex; with strong mid-dorsal posterior spine.

Antenna 2: articles 2 and 3 minutely tuberculate in longitudinal rows; articles 1-3 together as long as head and pereonites 2 and 3; article 4 1.4 times as long as this; article 5 0.85 times as long as article 4; articles 4 and 5 weakly setose; flagellum broken.

Coxa 1 with weak row of marginal short spines. Coxae 2-4 each with two to three spinules on posterolateral corners, largest on coxa 4. Coxae 3, 4 with spinules on anterior and posterior margins. Coxae 5-7 swollen, each with mid-ventral short spine on posterior margin engaging pair of small tubercles on anterior margin of following pereonite. Bases of pereopods 1-7 minutely and irregularly tuberculate; following articles unarmed. Dactylus of pereopods 2-4 1.2, 1.5 and 1.8 times length of propodus respectively, with rows of long setae along posterior margin, with long apical setiform unguis.

Pereopod 1 basis with small tooth; all articles setose along posterior margin; carpus postero-

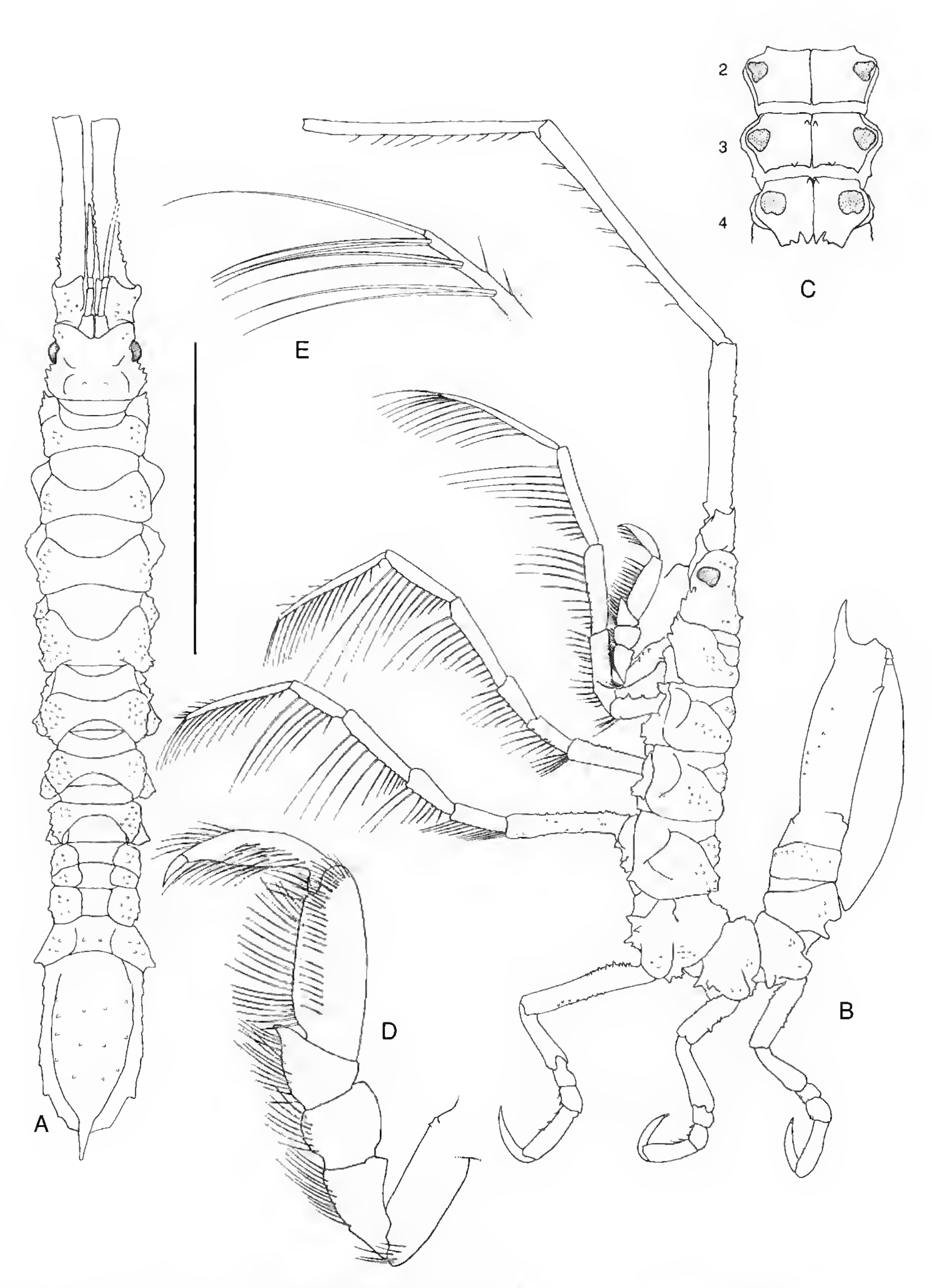


FIG. 1. — *Chaetarcturus crosnieri* n.sp., holotype ♂ (NMV J16513); **A**, **B**, habitus; **C**, pereonites 2-4, ventral view; **D**, pereopod 1, mesial view; **E**, pereopod 2, tip of dactylus. Scale bar for habitus: 10 mm.

distally produced as a sharp tooth; propodus and dactylus setose on mesial face; dactylus swollen in proximal two thirds; unguis 20% of dactyl.
Pereopods 5-7 bases with four, three and two spines or denticles respectively; merus-propodus with short robust setae along posterior margins.
Uropod with two rami; endopod 80% length of exopod, with acute apex with one small distal seta.
Brown on head and mouthparts.

Ovigerous female, 25.5 mm
Pleonite 1 and pleotelson with well-developed posterolateral spines. Coxae 2-4 with ventral plates, well-developed on coxa 4, apically rounded and not meeting medially. Coxa 5 with tuberculate ventral lobe, oostegite absent.

Juvenile female, 20.5 mm
Oostegite 5 visible only as semicircular bud.

REMARKS
The species is very similar to *Chaetarcturus abyssicola* (Beddard, 1886). The latter differs only in a less produced mid-dorsal posterior spine on the pleotelson, being smoother, and most significantly in lacking any indication of the posterolateral spines on the pleotelson. The male holotype of *C. crosnieri* has only small posterolateral lobes on the pleotelson and in this way resembles the smallest juveniles. All the adult females and larger juveniles have well-developed posterolateral pleotelsonic spines. Although the holotype comes from an area remote from New Caledonia where all others were collected, it is difficult to conclude that more than one species is involved because the general spination pattern is consistent in all material (except in the relatively smoother juveniles). The only male from New Caledonia has a damaged pleotelson but no spine is visible.

Chaetarcturus taniae n.sp.
(Figs 3, 4)

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL stn CP26, 22°39.66'S - 166°26.37'E, 1618-1740 m, 28.VIII.1985: holotype, ♂, 13.8 mm (MNHN Is5078).

DISTRIBUTION. — New Caledonia; 1618-1740 m (type locality only).

ETYMOLOGY. — For Tania Bardsley, Melbourne, who helped with the recognition and illustration of some of these species.

DESCRIPTION
Holotype
Head with pair of strong dorsolateral spines anterior to eyes, second pair of dorsolateral spines posterior to eyes, lateral margin with denticles.
Pereonite 1 well-differentiated from head laterally, with pair of dorsal submedian and pair of shorter dorsolateral spines posteriorly. Pereonites 2-4 each with pair of dorsal submedian spines posteriorly, pair of dorsolateral spines and pair of lateral spines; pereonite 4 with pair of dorsal submedian denticles anteriorly.
Pereonites 5-7 each with pair of dorsal submedian spines posteriorly, pair of dorsolateral spines becoming more lateral on pereonites 6 and 7; pereonite 5 with pair of lateral denticles.
All pleonites and telson immoveably fused. Pleonites 1-3 each with pair of dorsal submedian spines, pair of dorsolateral spines and pair of lateral spines (all posteriorly curved), dorsolateral spines longest and most posteriorly directed on pleonite 3. Remaining pleotelson domed, distinguished from more anterior region by deep transverse groove, with mid-dorsal row of three spines, two pairs of dorsolateral spines, three pairs of smaller spines near lateral margins, the last overreaching the broadly angled apex.
Antenna 2: article 2 with one upper spine; article 3 with three upper spines, last the longest, and one distolateral spine; articles 1-3 together as long as head and pereonites 1-2; article 4 1.5 times as long as this; article 5 1.3 times as long as article 4; flagellum of 6 articles, first very long, plus minute claw.
Coxa 1 with irregular anterolateral and lateral teeth. Coxae 2 and 3 each with minute denticles laterally. Coxa 4 with lateral denticles, ventral plate with two denticles on posterior margin. Coxae 5-7 (indistinguishable from pereonite) each with one lateral spine. Basis of pereopod 1 unarmed; bases of pereopods 2-4 with irregular denticles along anterior margins; merus and carpus of pereopod 2 with one distal spine; basis

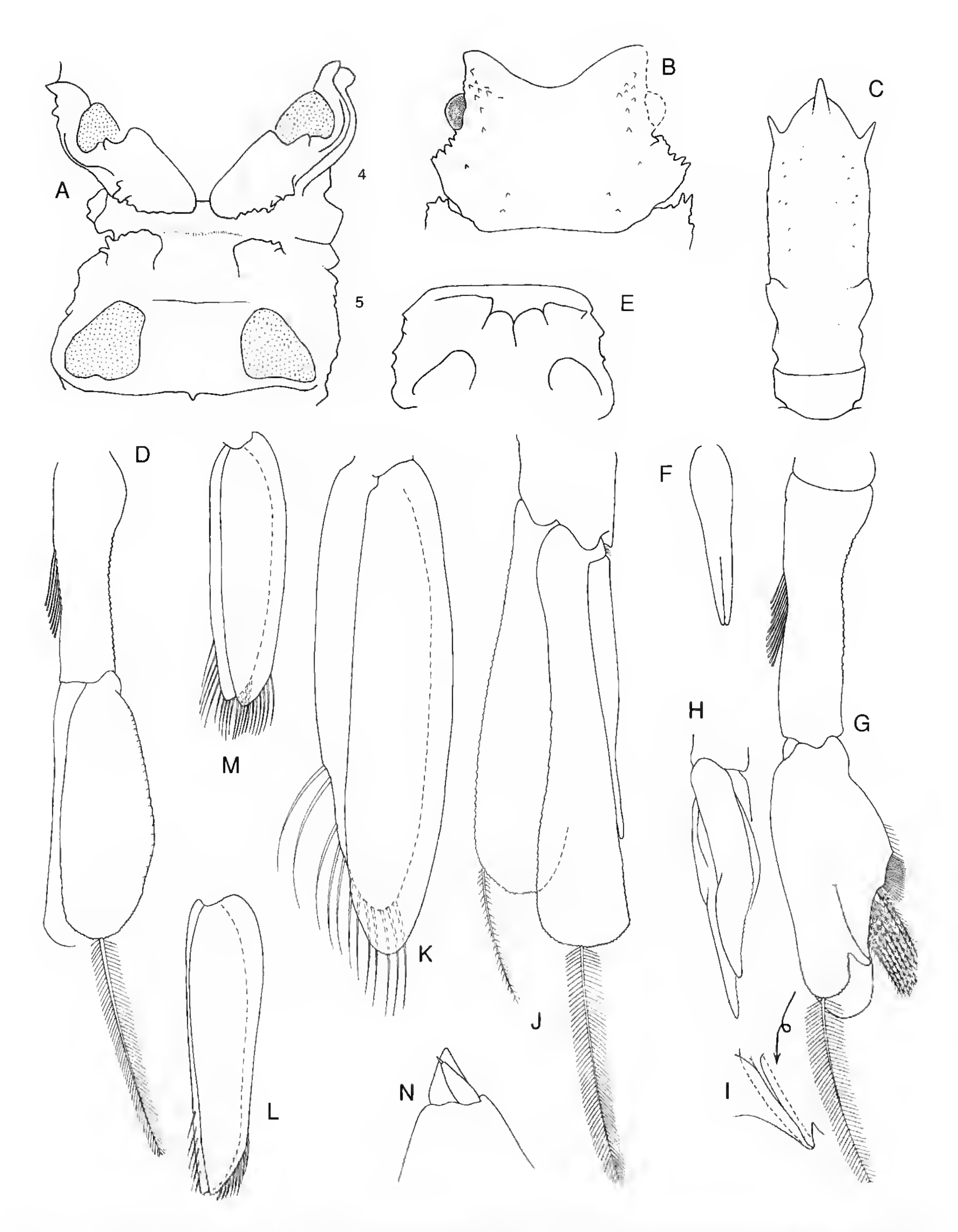


FIG. 2. — *Chaetarcturus crosnieri* n.sp.; **A-D**, paratype, ovigerous ♀ (MNHN Is5074); **A**, pereonites 4-5, ventral view; **B**, head; **C**, pleonite 1 and pleotelson; **D**, pleopod 1; **E**, paratype, juvenile ♀ (MNHN Is5072), pleonite 5; **F-M**, holotype ♂ (NMV J16513); **F**, penial plate; **G, H**, pleopod 1, anterior and lateral views; **I**, pleopod 1, detail of posterolateral lobe of exopod; **J-M**, pleopods 2-5 (4 and 5 half scale of others); **N**, uropodal rami.

and ischium of pereopod 4 with one distal spine; propodus unarmed. Dactylus of pereopods 2 and 4 1 and 1.4 times length of propodus respectively, with rows of long setae along posterior margin, with long apical setiform unguis. (Pereopod 3 unknown.)

Pereopods 5 and 6 bases with short irregular denticles posteriorly; merus-propodus with short robust setae along posterior margins.

Uropod with irregular row of six denticles.

Remarks

Chaetarcturus taniae is a typical *Chaetarcturus*, spinose and with paired posterodorsal pleotelso-

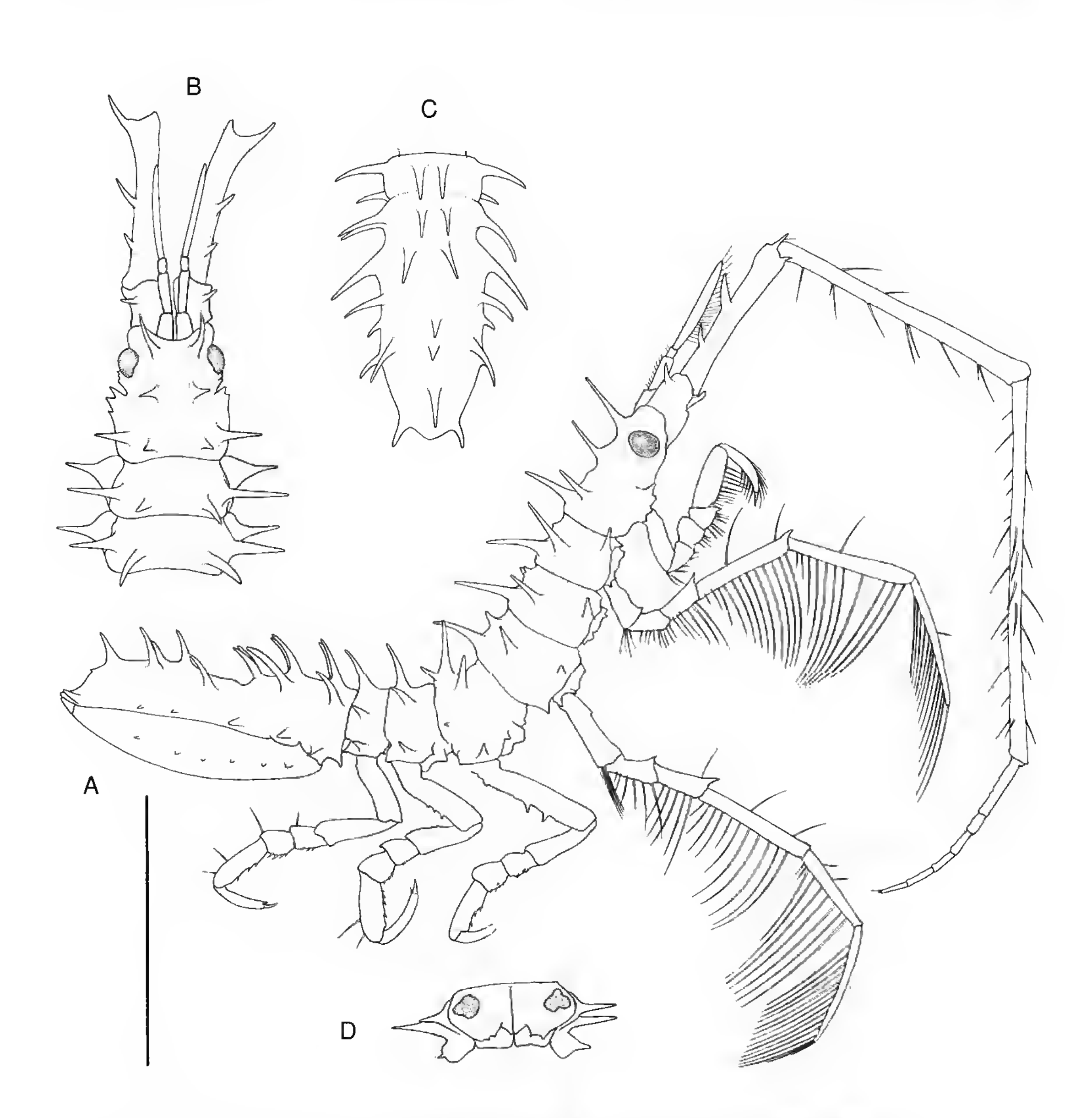


Fig. 3. — *Chaetarcturus taniae* n.sp.; holotype ♂ (MNHN Is5078); **A**, habitus, lateral view; **B**, head and pereonites 1-3; **C**, pleonite 1 and pleotelson; **D**, pereonite 4, ventral view. Scale bar for habitus: 10 mm.

nic spines. It has fewer dorsal spines than *C. longispinosus* and *C. bovinus* and differs from all species in the possession of three median spines on the posterior half of the pleotelson.

Genus *Dolichiscus* Richardson, 1913

Dolichiscus Richardson, 1913: 13-14. – Hale 1946: 197. – Schultz 1981: 71-73. – Wägele 1989: 139-140; 1991: 98. – Brandt 1990: 140-142; 1991: 151-152.

Paradolichiscus Schultz, 1981: 80-81 (type species *Antarcturus gaussianus* Vanhöffen, 1914 by original designation). – Wägele 1989: 139-140; 1991: 112. – Brandt 1991: 151-152.

TYPE SPECIES. — *Dolichiscus pfefferi* Richardson, 1913 (by original designation).

DIAGNOSIS

Body geniculate. Female pereonite 4 about as long as pereonites 2, 3. Pleonite 1 elongate, its

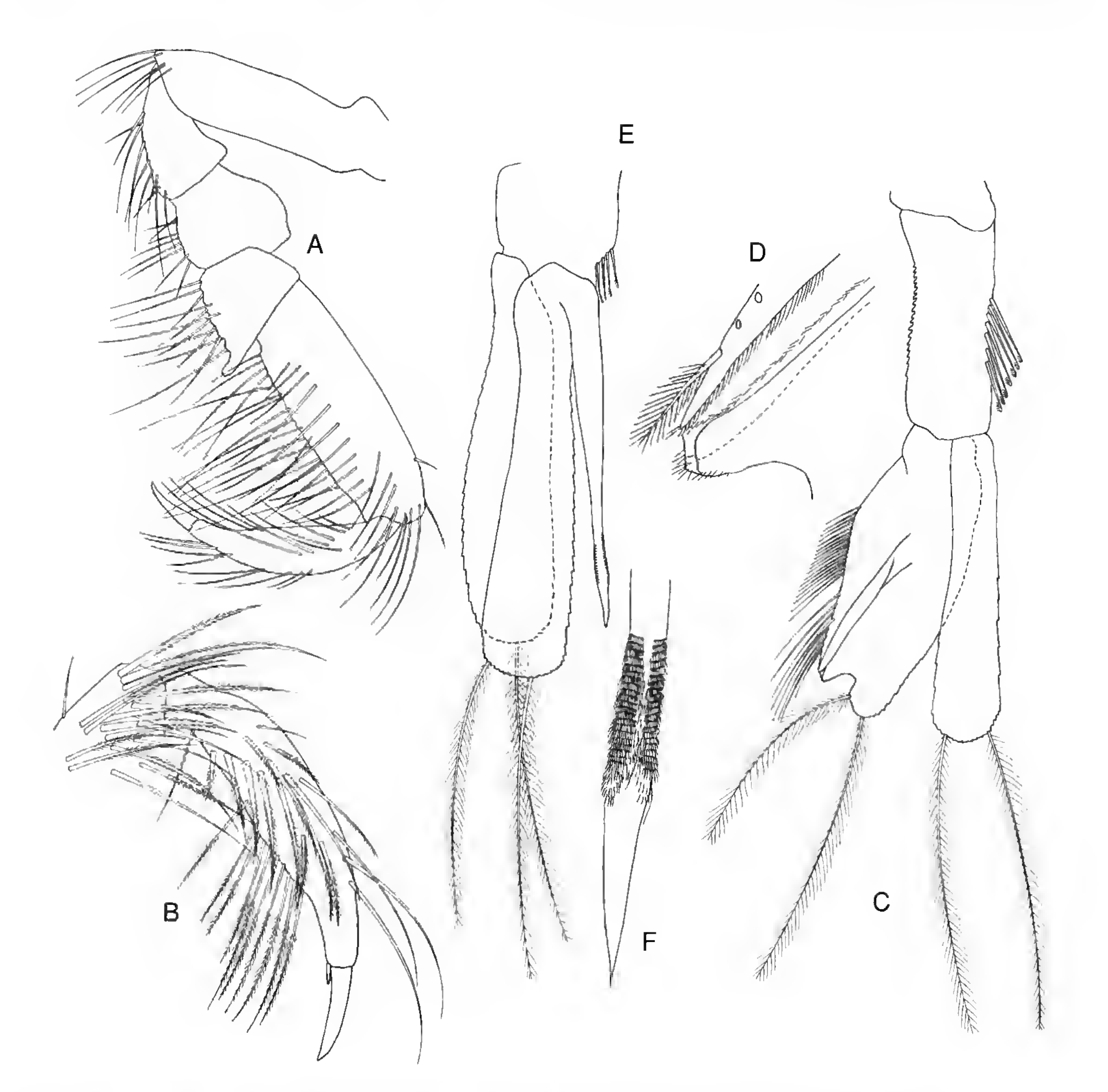


FIG. 4. — *Chaetarcturus taniae* n.sp.; holotype ♂ (MNHN Is5078); **A**, pereopod 1; **B**, pereopod 1, dactylus; **C**, pleopod 1; **D**, pleopod 1, detail of end of groove and distolateral lobe; **E**, pleopod 2; **F**, pleopod 2, tip of appendix masculina.

suture with pleotelson strongly oblique in lateral view, sometimes weakly articulating. Pleotelson with mid-dorsal ridge. Paired pleotelsonic posterior spines absent; medial pleotelsonic posterior spine present. Mouthparts and pereopod 1 exposed in lateral view. Antenna 2 peduncle with few setae; flagellum of more than 8 articles. Pereopod 1 dactylus lobed anteriorly, with unguis. Pereopods 2-4 dissimilar to pereopods 5-7, with rows of paired long setae. Pereopods 2-4 dactylus shorter than propodus, without posterior row of setae; unguis setiform. Pereopod 4 about as long as pereopod 3, of similar form. Pereopods 5-7 elongate. Penes fused. Male pleopod 1 exopod thickened, parallel-sided for most of length, obliquely grooved, groove ending distolaterally on a triangular lobe. Oostegite 4 supported by ventral coxal process. Oostegite 5 absent in ovigerous female.

REMARKS

Schultz (1981) separated *Paradolichiscus* from *Dolichiscus* only on the basis of possession of "short or long dorsal and coxal spines". All species of *Dolichiscus* are more or less spinose, the degree of spination being a useful specific character. The species assigned to his new genus by Schultz are not much more spinose than those placed in *Dolichiscus* and there is no clear division between the two. The two genera are therefore synonimized. Wägele (1989) recognised the similarity of the two genera, proposing that an elongate antennal 2 flagellum was a synapomorphy linking them. He was unable to find automorphies for either but retained them as separate genera in 1991. Similarly, Brandt (1991) placed the two genera together without synapomorphies or autapomorphies in her cladogram.

Brandt (1990) contradicted Richardson's (1913) and Schultz's (1981) opinion that pleonite 1 is free by stating that although indicated by a deep groove it is not movable. There certainly is a clear well-marked oblique "suture" between pleonite 1 and the pleotelson and, in fixed material, slight movement between them. This is quite different from the situation in *Antarcturus* for example where there is no indication, except on the edges of the epimera, of pleonite 1 which is truly fused into the pleotelson.

The seventeen known species of *Dolichiscus* are distinguished on the basis of body and limb ornamentation. Mouthparts are not informative for species recognition (see Brandt 1990 and Pires & Sumida 1997 for good examples) and are not figured here. Three species of *Dolichiscus* were found in these collections.

Dolichiscus cornutus (Beddard, 1886)
(Figs 5, 6)

Arcturus cornutus Beddard, 1886a: 108. – 1886b: 93-94, pl. 19 figs 6-12.

Dolichiscus cornutus – Brandt 1990: 142.

MATERIAL EXAMINED. — **Philippines.** Samboangan, HMS *Challenger* stn 214, 04°33'N - 127°06'E, 10.II.1875, 920 m: holotype ovigerous ♀, 36 mm (BMNH 1889.4.27.84).

Indonesia. Tanimbar Islands, KARUBAR stn CP53, 08°18'S - 131°41'E, 1026-1053 m, 30.X.1991: figured ♂, 35.6 mm (MNHN Is5079). — Stn CP52, 08°03'S - 131°48'E, 1244-1266 m, 30.X.1991: ♂, 31.7 mm (MNHN Is5080). — Stn CP87, 08°47'S - 130°49'E, 1017-1024 m, 5.XI.1991: 1 ♂, 34.1 mm; 1 ovigerous ♀, 38.3 mm (NMV J44024).

New Caledonia. BATHUS 1 stn CP651, 21°41.80'S - 166°40.10'E, 1080-1118 m, 11.III.1993: ovigerous ♀, 44.0 mm (MNHN Is5081). — Stn CP660, 21°10.48'S - 165°53.19'E, 786-800 m, 13.III.1993: ♂, 25.7 mm (NMV J44025). — Stn CP662, 21°01.03'S - 165°48.70'E, 960 m, 13.III.1993: ♂, 38.1 mm; juvenile, 28.0 mm (MNHN Is5082).

BATHUS 4 stn CP951, 21°31.44'S - 164°54.97'E, 960 m, 10.VIII.1994: ovigerous ♀, 38.0 mm (MNHN Is5083).

BIOCAL stn CP61, 24°11'S - 167°32'E, 1070 m, 2.IX.1985: juvenile ♀, 42.1 mm; ovigerous ♀, 45.2 mm (MNHN Is5084). — Stn CP62, 24°19'S - 167°49'E, 1395-1410 m, 2.IX.1985: ♀ bearing juveniles, 42 mm; ovigerous ♀, 37.2 mm (NMV J44026).

BIOGEOCAL stn CP232, 21°33.53'S - 166°23.1'E, 530 m, 12.IV.1987: ♂, 30.2 mm (MNHN Is5085). — Stn CP297, 20°38.64'S - 167°10.77'E, 1230-1240 m, 28.IV.1987: 2 ovigerous ♀♀, 38 and 46 mm (MNHN Is5086).

Chesterfield Islands. MUSORSTOM 5 stn CP323, 21°18.52'S - 157°57.62'E, 970 m, 14.X.1986: ♂, 31.5 mm; juvenile 33.6 mm (MNHN Is5087). — Stn CP324, 21°15.01'S - 157°51.33'E, 970 m, 14.X.1986: juvenile 26.8 mm (MNHN Is5088).

DISTRIBUTION. — Philippines, Indonesia, New Caledonia; 530-1410 m depth.

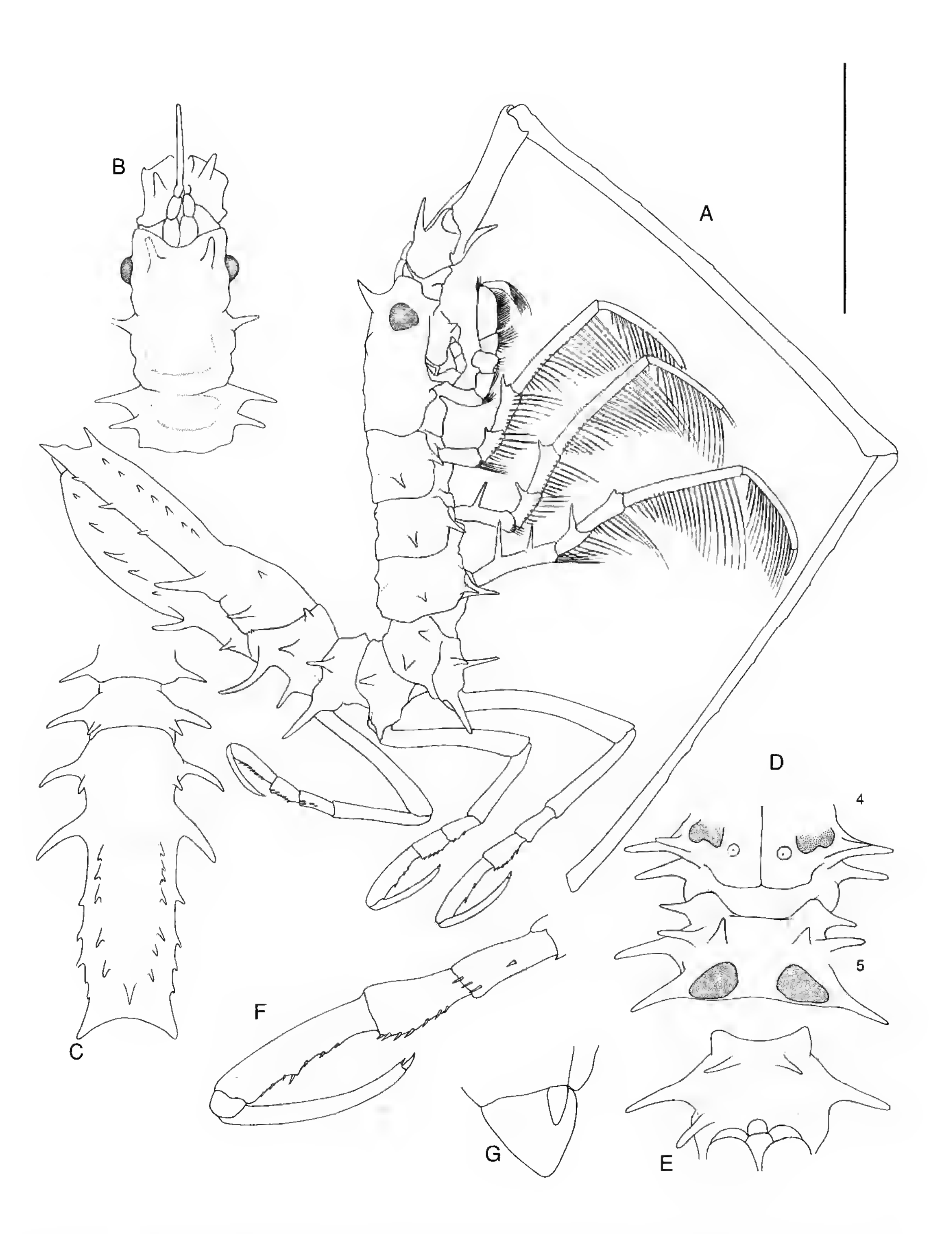


FIG. 5. — *Dolichiscus cornutus* (Beddard, 1886) ♂ (MNHN Is5079); **A**, habitus; **B**, head, pereonites 1-2; **C**, pleonite 1 and pleotelson; **D**, pereonites 4 and 5, ventral view; **E**, pleonite 1, ventral view; **F**, pereopod 5; **G**, uropodal rami. Scale bar for habitus: 10 mm.

Description

Figured 35.6 mm male

Head with pair of dorsolateral spines.

Pereonite 1 with pair of obscure dorsolateral bosses, pair of lateral spines, and two dorsal transverse low ridges. Pereonites 2-4 each with two pairs of lateral spines (lower pair marginal) and two dorsal transvere low ridges, one near anterior margin and other near posterior margin. Pereonite 5 with two pairs of lateral spines (horizontally arranged), and one dorsal transverse low ridge. Pereonites 6 and 7 each with one pair of lateral spines and one dorsal transverse low ridge.

Pleonite 1 with pair of dorsolateral spines, pair of lateral spines, two pairs of ventrolateral spines (posterior pair longer), minute spine on lower posterlateral margin, and two pairs of ventral spines (posterior pair longer). Pleonites 2-5 and telson fused, only area of pleonite 2 distinguishable from remainder by lateral indentation and ventrolateral notch. Pleonite 2 articulating freely from pleonite 1, with pair of dorsolateral and pair of lateral spines. Pleonite 3 with pair of lateral spines. Remaining pleotelson with dorsolateral rows each of seven spines, lateral margins convex each with row of three spines (plus obscure denticles), median dorsal posterior spine, and concave posterior margin separating pair of diverging flat posterolateral spines.

Antenna 2: article 2 with one upper spine; article 3 with lower spine; articles 1-3 together as long as head-pereonite 2; article 4, 2.5 times as long as this; article 5, 1.05 times as long as article 4; flagellum (broken) of more than six articles.

Coxae 1-3 unarmed. Coxa 4 with lateral spine and spine on ventral coxal plate. Coxa 5 with one lateral spine and three spines anterior, antero- and posterolateral to basis socket. Coxae 6 and 7 (indistinguishable from pereonite) each with lateral spine. Basis of pereopod 1 with minute proximal anterior denticle; bases of pereopods 2-4 with zero, one, two anterior spines respectively; ischium and merus of pereopods 2-4 each with one distal spine; remaining articles unarmed. Dactylus of pereopods 2-4 about 0.3 length of propodus, with one long apical seta.

Pereopods 5-7 bases unarmed; merus-propodus with short robust setae along posterior margins.

Penial plate split in distal third.

Pleopod 1 peduncle thickened, with nine coupling hooks, irregularly denticulate along lateral margin; endopod as long as exopod, both 1.1 times as long as peduncle. Endopod thickened through most of length; with marginal plumose setae distally, setae up to two thirds length of endopod; medial and lateral setae shorter; diagonal groove along posterior face enclosed as a channel by overlying flaps in distal two thirds of endopod and opening near the apex of a triangular projection, extending as far as half endopod width and with a soft convex distal margin. Pleopod 2 peduncle about quarter length of that of pleopod 1, with six coupling hooks; rami membranous; endopod broader and 1.15 times as long as exopod, both rami with marginal plumose setae up to two thirds length of rami; appendix masculina just shorter than endopod, tapering and distally curved anteriorly. Pleopod 3 as long as pleopod 2, with short peduncle, without coupling hooks; rami membranous; endopod just shorter than exopod, with sparse marginal short plumose setae; exopod enclosing endopod proximally. Pleopods 4 and 5 longer than others; peduncle short and narrower than rami; rami membranous; endopods subacute, with short distolateral plumose setae; exopod enclosing endopod proximally.

Uropod with anterior spine, longer second spine and row of five shorter spines (third longest); endopod half length of exopod, tapering.

Ovigerous 38 mm female

Differs from male in presence of oostegites on pereonites 1-4 and broader and deeper pereon. Head with additional pair of smaller dorsolateral spines. Pereonites 1-4 each with additional pair of short posterolateral spines. Pereonite 5 with strongly concave anterior margin of sternite. Pleotelson with dorsolateral rows each of eight spines. Coxae 2-4 each with additional medially-directed strong spine supporting marsupium. Coxa 4 ventral plate with additional pair of posterolaterally directed spines. Pereopod 3 basis with two spines. Coxa 7 with additional anterior spine. Pereopods 2-4 with basis relatively longer than in male and curved. Uropod with row of seven spines of uneven lengths.

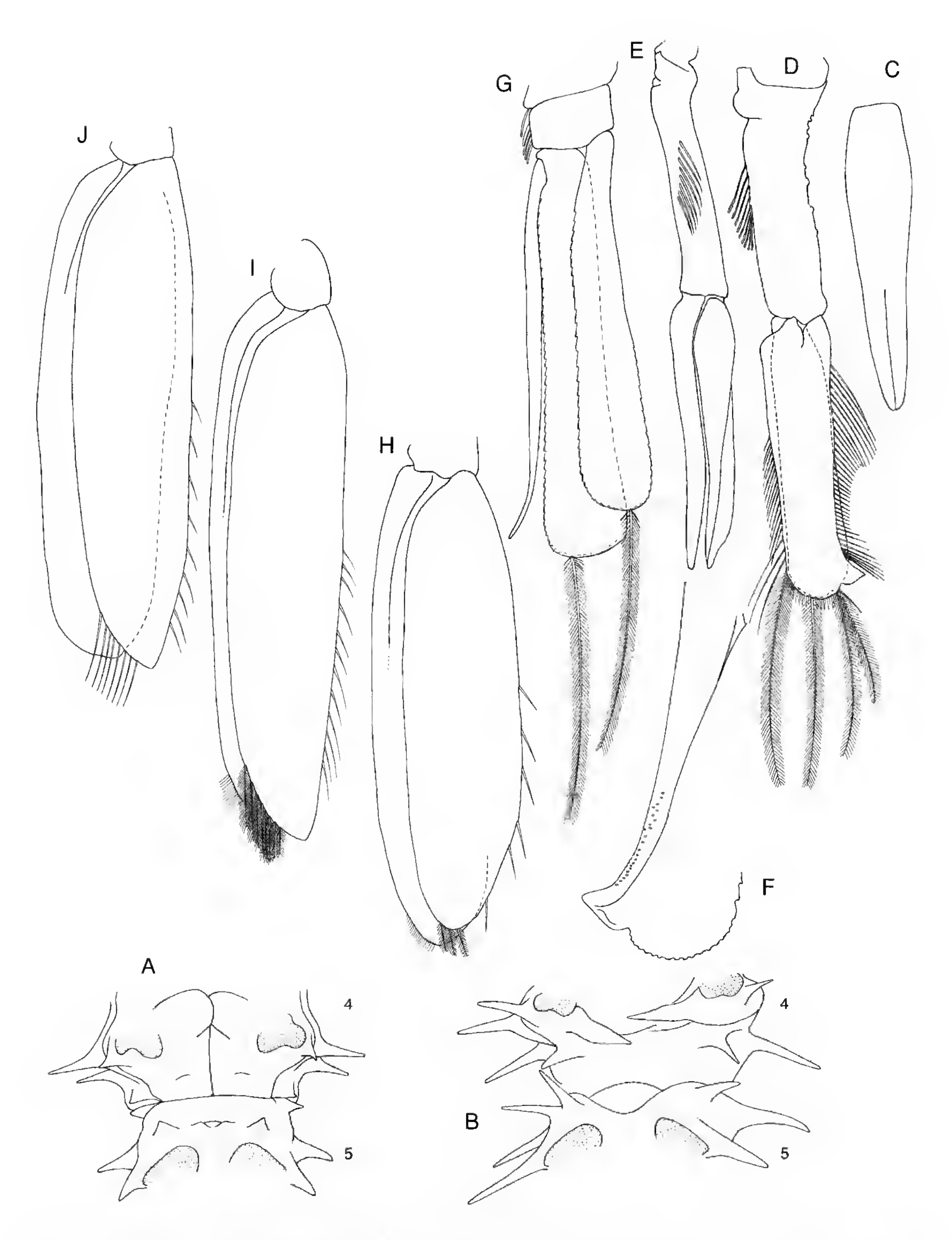


FIG. 6. — *Dolichiscus cornutus* (Beddard, 1886); **A**, juvenile ♀ (MNHN Is5084), pleonites 4 and 5, ventral view; **B**, ovigerous ♀ (NMV J44024), pereonites 4 and 5, ventral view; **C-J**, ♂ (MNHN Is5079); **C**, penial plate; **D**, **E**, pleopod 1, anterior and medial views; **F**, pleopod 1, detail of end of groove and lobe; **G-J**, pleopods 2-5.

Juvenile 42 mm female
With overlapping oostegite buds on pereonites 1-4. Pereonite 5 with pair of short lobes covering oopores on anterior margin of sternite.

Other variation
Other ovigerous females have an extra spine on the basis of pereopods 2-4. The smaller juveniles from Chesterfield Islands have reduced spination on the pleotelson.

REMARKS
The ovigerous female holotype from the Philippines was examined and found to fall within the variability of the large collection from Indonesia and New Caledonia. It differed most noticeably from the specimen illustrated here in having ten spines on the uropods in two rows, whereas only a single row of about six spines is more typical.
The species is distinguished from others in this collection by the presence of a spinose or serrate dorsolateral ridge on the pleotelson and an irregular row of six to seven spines on the uropod. The first and second uropodal spines are much larger than those in the ridge. There is considerable variability in the degree of spination on the body and legs. The basis of at least pereopods 2-4 has a spine but in some individuals there is also a spine on the basis of pereopods 1 and 6, or more spines than usual on the other legs. Larger specimens tend to be more spinose than smaller ones.
The two small specimens from the Chesterfield Islands differ from the others but are not differentiated as a separate species because of the wide range of variability within specimens from nearby New Caledonia. These two only have obscurely dentate dorsolateral ridges on the pleotelson ending in a strong spine.

Dolichiscus kai n.sp.
(Figs 7-9)

MATERIAL EXAMINED. — **Indonesia.** Tanimbar Islands, KARUBAR stn CP38, 07°40'S - 132°27'E, 620-666 m, 28.X.1991: holotype, ♂, 27 mm (MNHN Is5089). — Kai Islands, KARUBAR stn CP20, 05°15'S - 132°59'E, 769-809 m, 25.X.1991: paratypes, 8 ovigerous ♀♀, 22-30 mm; 6 ♂♂, 20-29 mm (MNHN Is5090); 2 ♂♂, 2 ♀♀ (NMV J44027). — Stn CP19, 05°15'S - 132°01'E, 605-576 m, 25.X.1991: paratypes, 4 ovigerous ♀♀, 26-29 mm (MNHN Is5091); 1 ♂, 24 mm (MNHN Is5092). — Stn CC21, 05°14'S - 133°00'E, 688-694 m, 25.X.1991: paratypes, 2 ovigerous ♀♀, 22, 30 mm (MNHN Is5093).

ETYMOLOGY. — For the Kai Islands, Indonesia; noun in apposition.

DISTRIBUTION. — Eastern Indonesia; 576-809 m depth.

DESCRIPTION
Holotype
Head with pair of dorsolateral spines.
Pereonite 1 with pair of dorsolateral spines, two pairs of lateral spines (anterior pair longer), and two dorsal transverse obscure ridges. Pereonites 2-4 each with pair of dorsolateral spines, two pairs of lateral spines (anterior pair longer) and transverse obscure ridge near posterior margin. Pereonite 4 with minute ventrolateral spine.
Pereonite 5 with two pairs of lateral spines (horizontally arranged), two dorsal transverse low ridges. Pereonites 6 and 7 each with one pair of lateral spines and one dorsal transverse low ridge.
Pleonite 1 with pair of dorsolateral spines and two pairs of ventrolateral spines (posterior pair longer). Pleonites 2-5 and telson fused, only area of pleonite 2 distinguishable from remainder by lateral indentation and ventrolateral notch. Pleonite 2 articulating freely from pleonite 1, with pair of dorsolateral and pair of lateral spines. Pleonite 3 with pair of lateral spines. Remaining pleotelson with dorsolateral rows each of up to six irregular tubercles, lateral margins parallel, with weak denticles, median dorsal posterior spine, and straight posterior margin separating pair of parallel flat posterolateral triangular projections.
Antenna 2 article 2 with one upper spine; article 3 with weak lower spine; articles 1-3 together as long as head-pereonite 2; article 4 2.1 times as long as this; article 5 and flagellum unknown.
Coxae 1-3 unarmed. Coxa 4 with lateral spine. Coxa 5 with one lateral spine and one spine anterior to basis socket. Coxae 6 and 7 (distinguishable from pereonite) each with lateral spine. Basis of pereopod 1 with minute proximal anterior denticle; bases of pereopods 2-4 with two,

two, three anterior spines respectively; ischium and merus of pereopods 2-4 each with one distal spine; remaining articles unarmed. Dactylus of pereopods 2-4 about 0.2 length of propodus, with one long apical seta.

Pereopod 5 basis unarmed; pereopods 6 and 7 bases each with one spine; merus-propodus with short robust setae along posterior margins.

Penial plate split in distal third.

Pleopod 1 peduncle thickened, with six coupling hooks, irregularly denticulate along lateral margin; endopod as long as exopod, both 1.4 times as long as peduncle. Endopod thickened through most of length; with marginal plumose setae distally, setae up to two thirds length of endopod; medial and lateral setae shorter; diagonal groove

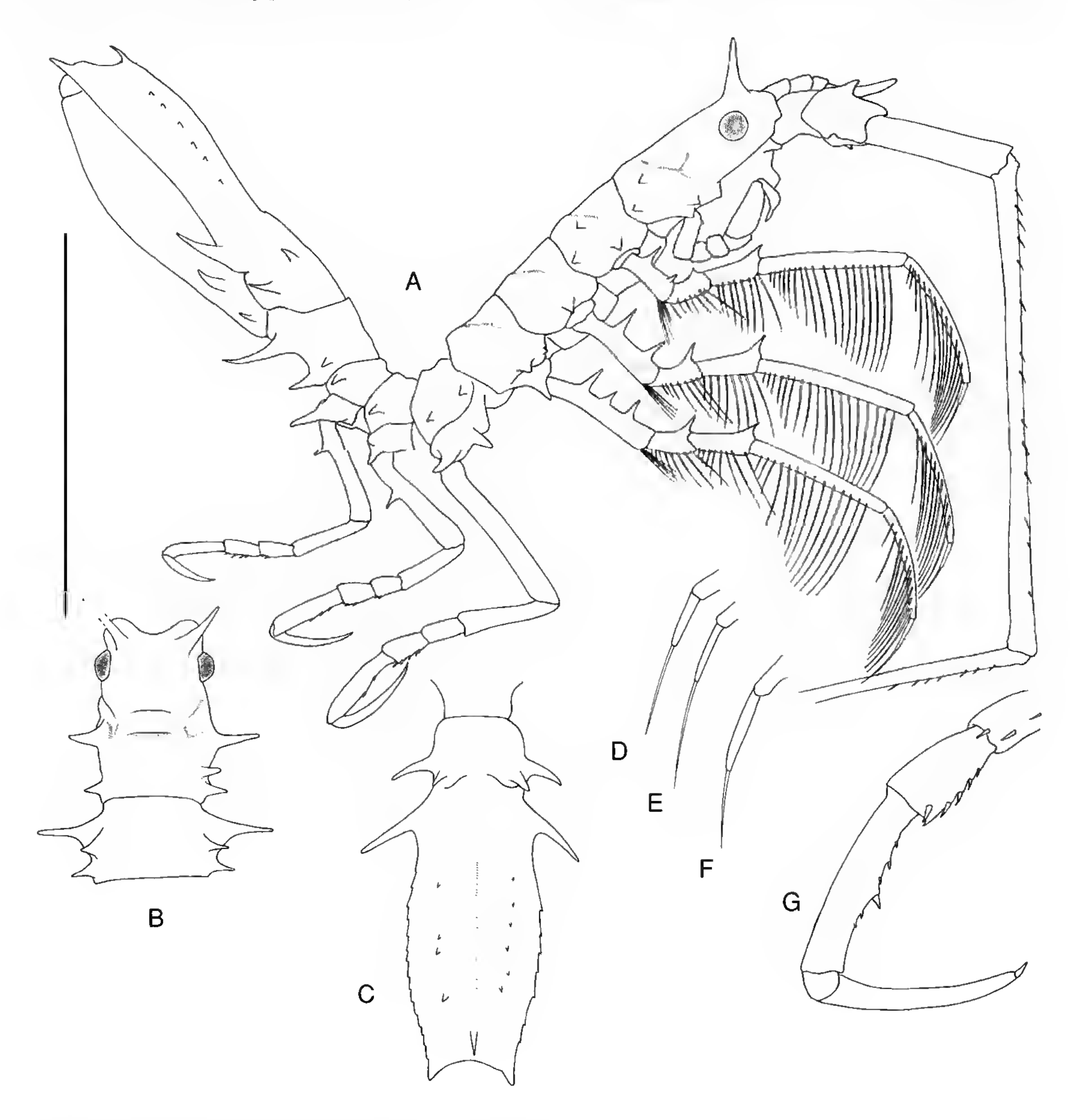


FIG. 7. — *Dolichiscus kai* n.sp., holotype ♂ (MNHN Is5089); **A**, habitus; **B**, head and pereonites 1-2; **C**, pleonite 1 and pleotelson; **D**-F, pereopods 2-4, dactyli; **G**, pereopod 5. Scale bar for habitus: 10 mm.

along posterior face enclosed as a channel by overlying flaps in distal two thirds of endopod and opening near the apex of a broad-based triangular projection, extending as far as 0.3 endopod width and with a soft convex distal margin. Pleopod 2 peduncle about quarter length of that of pleopod 1, with six coupling hooks; rami membranous; endopod broader and 1.15 times as long as exopod, both rami with marginal plumose setae up to two thirds length of rami; appendix masculina just shorter than endopod, tapering and distally curved anteriorly. Pleopods 3-5 as in *D. cornutus*.
Uropod with anterior spine and longer second spine about quarter way along; endopod half length of exopod, with truncate margin.

Ovigerous 27 mm female
Differs from male in presence of oostegites on pereonites 1-4, broader and deeper pereon, all spines longer. Pereonites 2-4 each with additional pair of anterolateral spines and additional pair of short posterolateral spines. Pleotelson with dorsolateral rows of five or six spines. Coxa 1 with anterior spine. Coxae 2-4 each with additonal posterolateral spines and additional medially-directed strong spine supporting marsupium. Coxa 4 ventral plate with additional pair of posterolaterally directed spines. Pereopod 5 basis with one spine. Coxa 5 with additional lateral spine. Pereopods 2-4 with basis relatively longer than in male and curved.

29 mm male
Antenna 2 peduncle article 4 2.1 times as long as articles 1-3 together, article 5 as long as 4; flagellum (broken) of more than sixteen articles.

REMARKS
Males smaller than that figured have only one spine on the uropod, lack spines on bases of pereopods 2-4 and any ornamentation on the dorsolateral ridge of the pleotelson. *Dolichiscus kai* differs from *D. cornutus* in the absence of a spine row on the distal part of the uropod, weaker spination of the pleotelson, its parallel sides, and the parallel (rather than diverging) posterolateral spines on the pleotelson.

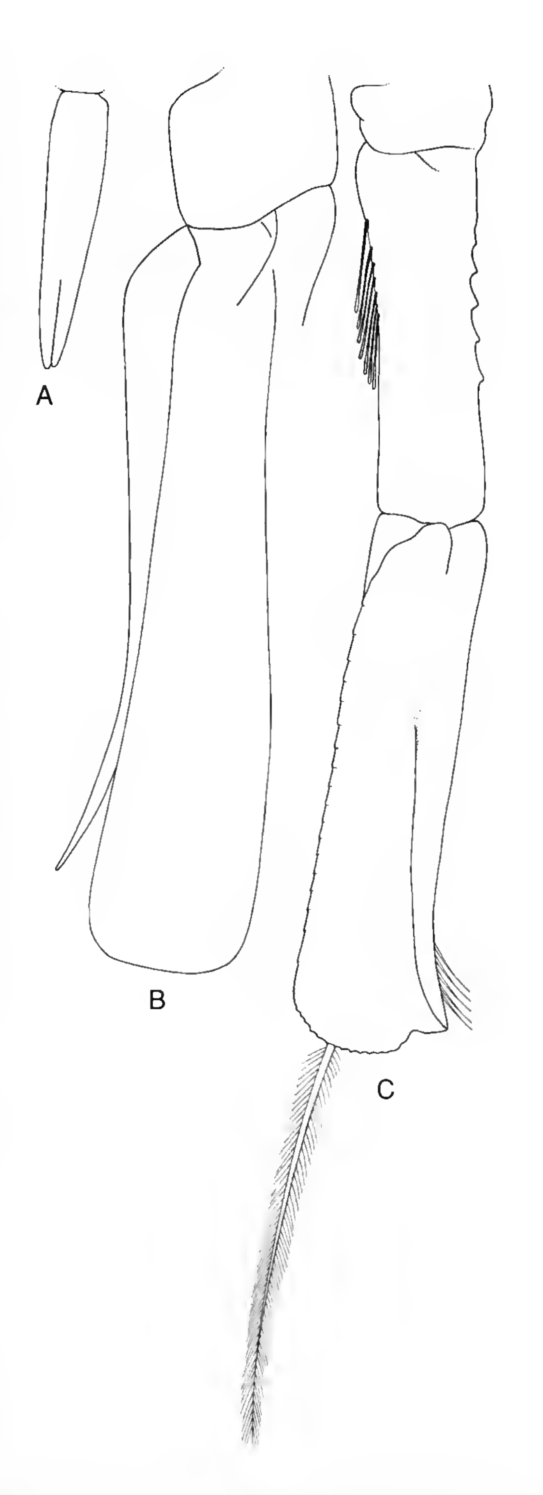


FIG. 8. — *Dolichiscus kai* n.sp., holotype ♂ (MNHN Is5089); **A**, penial plate; **B**, pleopod 2 (with endopod only); **C**, pleopod 1 (with exopod only).

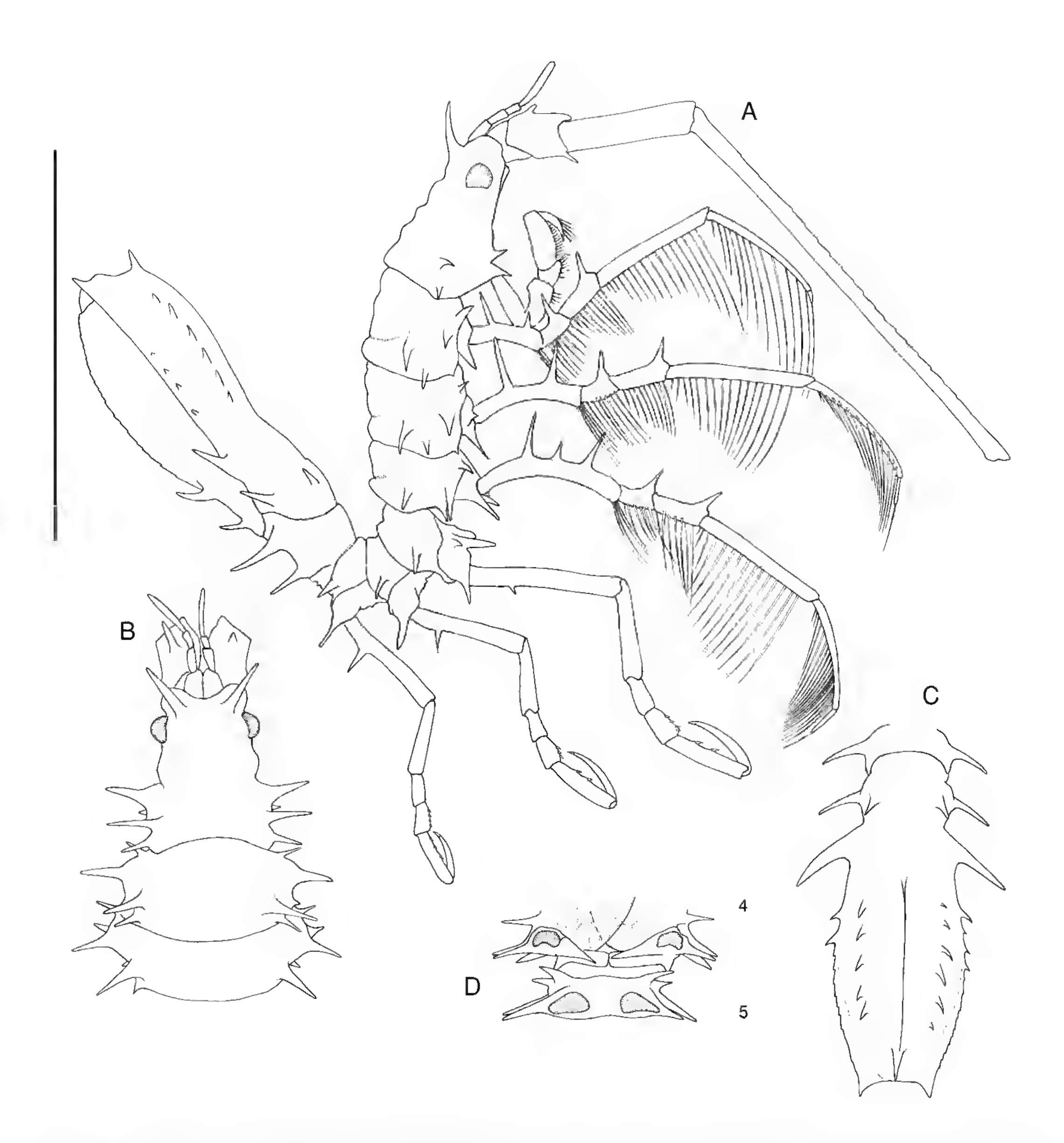


FIG. 9. — *Dolichiscus kai* n.sp., ovigerous ♀ (MNHN Is5091); **A**, habitus; **B**, head and pereonites 1-3; **C**, pereonite 1 and pleotelson; **D**, pereonites 4 and 5, ventral view. Scale bar for habitus: 10 mm.

Dolichiscus tanimbar n.sp.
(Figs 10, 11)

MATERIAL EXAMINED. — **Indonesia.** Tanimbar Islands, KARUBAR stn CP70, 08°41'S - 131°47'E, 413-410m, 2.XI.1991: holotype, ovigerous ♀, 23 mm (MNHN Is5094). — Stn CP69, 08°42'S - 131°53'E, 356-368 m, 2.XI.1991: paratype ♀ carrying juveniles, 24 mm (NMV J44028).

ETYMOLOGY. — For the Tanimbar Islands, Indonesia; noun in apposition.

DISTRIBUTION. — Eastern Indonesia; 356-410 m depth.

DESCRIPTION

Holotype

Head with pair of dorsolateral spines anterior to

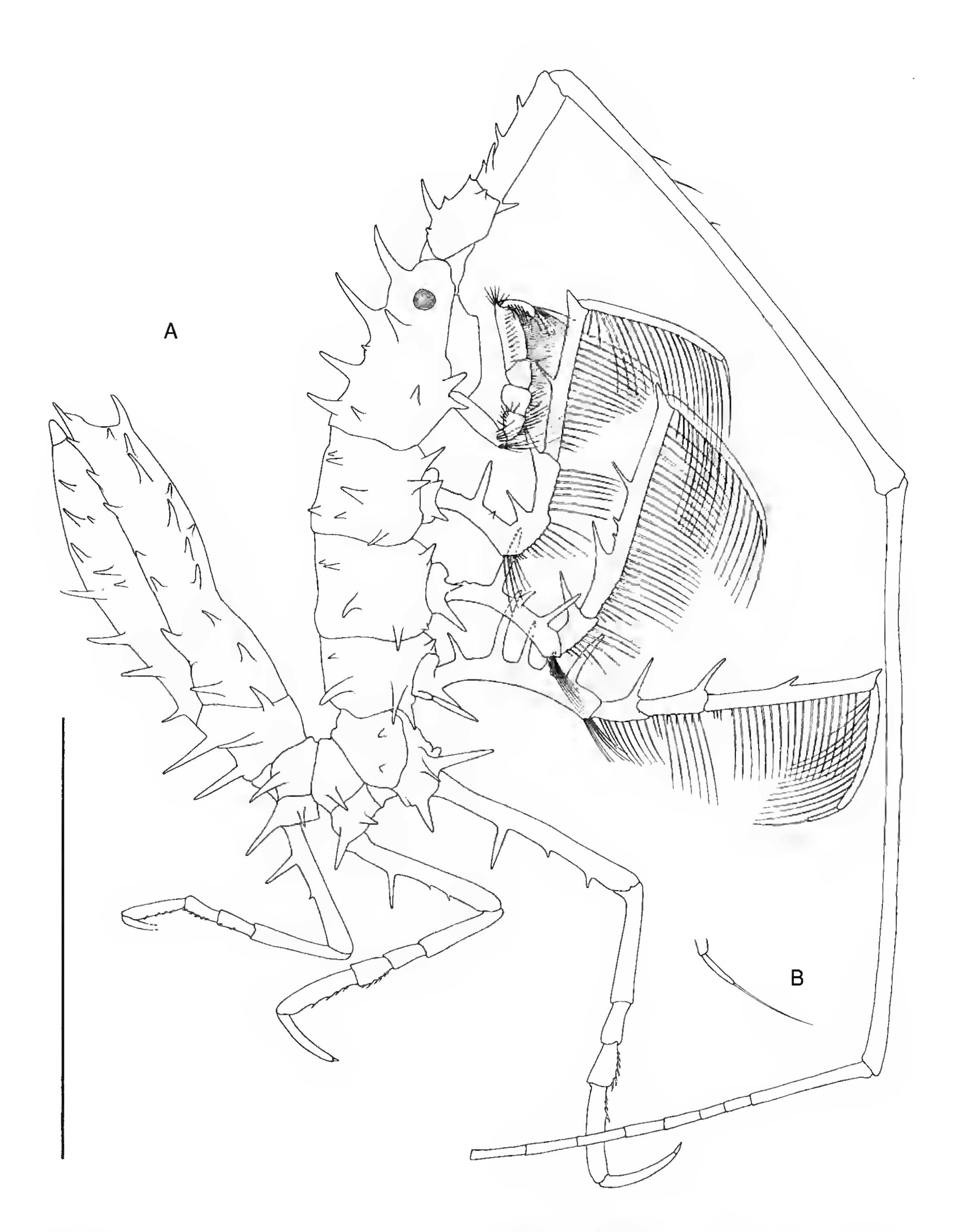


FIG. 10. — *Dolichiscus tanimbar* n.sp., holotype, ovigerous ♀ (MNHN Is5094); **A**, habitus; **B**, pereopod 2, dactylus. Scale bar for habitus: 10 mm.

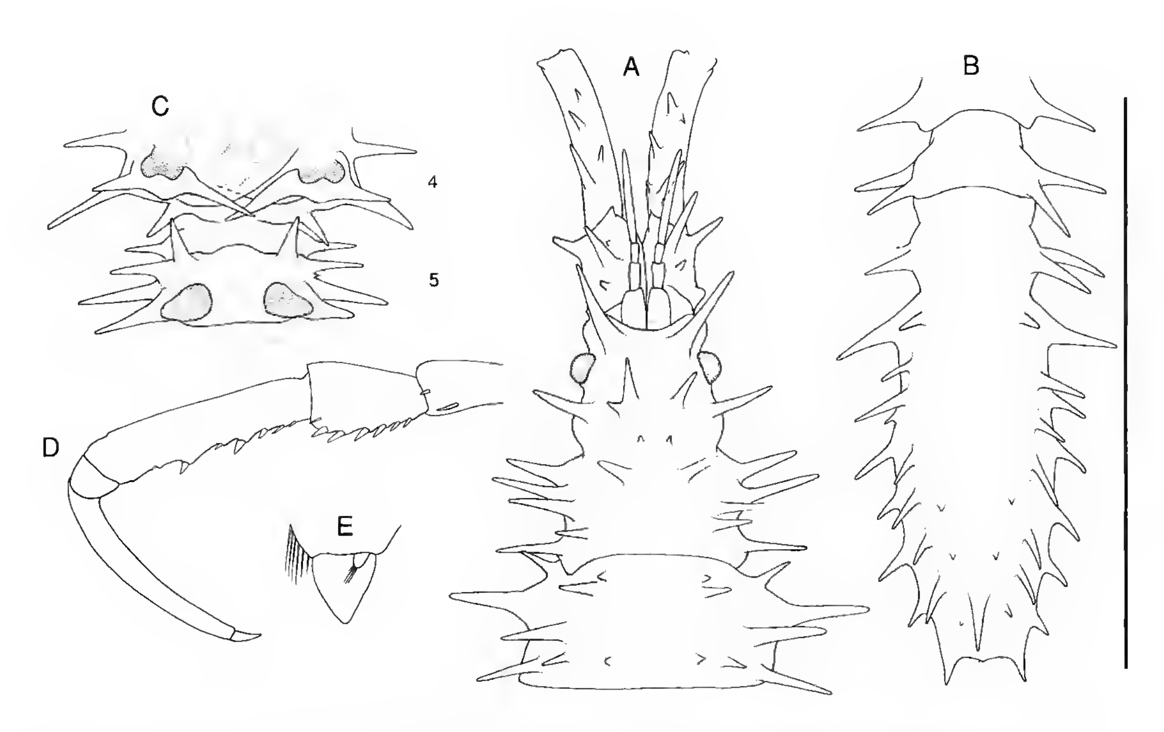


FIG. 11. — *Dolichiscus tanimbar* n.sp., holotype, ovigerous ♀ (MNHN Is5094); **A**, head and pereonites 1-2; **B**, pereonite 7, pleonite 1 and pleotelson; **C**, pereonites 4 and 5, ventral view; **D**, pereopod 5; **E**, uropodal rami. Scale bar for A-C: 10 mm.

eyes, pair of dorsolateral spines posterior to eyes (one with lateral spinule), pair of dorsolateral spines posterior to these, and pair of lateral spines. Pereonite 1 with two pairs of dorsolateral spines, and two pairs of lateral spines (more dorsal pair posterior to other pair). Pereonite 2 with two pairs of short dorsolateral spines anteriorly, one pair of dorsolateral spines posteriorly, four pairs of lateral spines (most ventral longest), and pair of anteroventral marginal spines. Pereonite 3 with two pairs of short dorsolateral spines anteriorly, two pairs of lateral spines (placed obliquely), one pair of anteroventral marginal spines, and one pair of posterolateral marginal denticles. Pereonite 4 with two pairs of short dorsolateral spines anteriorly, two pairs of lateral spines, one pair of anteroventral marginal spines, and one pair of posterolateral marginal spines.

Pereonite 5 with two pairs of lateral spines (horizontally arranged), one dorsal transverse low ridge. Pereonites 6 and 7 each with one pair of lateral spines and one dorsal transverse low ridge.

Pleonite 1 with pair of dorsolateral spines, pair of lateral spines, two pairs of ventrolateral spines (posterior pair longer), minute spine on lower posterolateral margin, and two pairs of ventral spines (posterior pair longer). Pleonites 2-5 and telson fused, only area of pleonite 2 distinguishable from remainder by ventrolateral notch. Pleonite 2 articulating freely from pleonite 1, with pair of dorsolateral and pair of lateral spines. Pleonite 3 with pair of lateral spines and pair of dorsolateral spines (longest of all pleotelson spines). Remaining pleotelson with dorsolateral rows each of six spines, two pairs of much smaller spines mediad to these rows in posterior half of dorsum, lateral margins convex each with row of five uneven spines, median dorsal posterior spine, pair of small spines on posterior face, and convex posterior margin separating pair of posteriorly-directed flat posterolateral teeth.

Antenna 2: article 2 with four upper spines, second the longest, and one lateral spine distally; article 3 with four irregularly spaced upper

spines, first the longest, and one lower spine; articles 1-3 together as long as head and half of pereonite 2; article 4, 2.3 times as long as this; article 5, 1.1 times as long as article 4; flagellum (broken) of more than eight articles.

Coxa 1 with one anterolateral and one lateral spines. Coxae 2 and 3 each with one lateral and one posterolateral spine. Coxa 4 with one lateral and one posterolateral spine, lateral spine and medially-directed strong spine supporting marsupium. Coxa 5 with two lateral spines (more posterior longer) and two spines anterior and posterolateral to basis socket. Coxae 6 and 7 (distinguishable from pereonite) each with two lateral spines (more posterior longer). Basis of pereopod 1 unarmed; bases of pereopods 2-4 with two, three, five anterior spines respectively; ischium and merus of pereopods 2-4 each with one distal spine; carpus of pereopods 2-4 each with one spine at midpoint and one spine distally (two smaller more proximal spines on pereonite 4); propodus unarmed. Dactylus of pereopods 2-4 about 0.25 length of propodus, with one long apical seta.

Pereopods 5-7 bases with four, three and two spines or denticles respectively; merus-propodus with short robust setae along posterior margins.

Uropod with irregular row of seven spines along middle, three more lateral; endopod 0.3 length of exopod, with rounded setose apex.

REMARKS

This species is more spinose than others of *Dolichiscus* in these collections and resembles species included by Schultz (1981) in *Paradolichiscus*, a genus I have synonymized with *Dolichiscus*. It is similar to *D. opiliones* (Schultz, 1981) from New Zealand but its dorsal spines are more prominent. A notable similarity between the two species is the pleopod 1 of the male. Schultz's figure shows the pleopod 1 to be typical of the genus.

Acknowledgements

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New records of freshwater Palaemonidae (Crustacea, Decapoda) from New Caledonia

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ABSTRACT
A freshwater survey of over thirty-five river catchments throughout mainland New Caledonia ("*la Grande Terre*") and a number of caves on Lifou, the Loyalty Islands, yielded four new records of Palaemonidae for the region, viz., *Macrobrachium grandimanus* (Randall, 1839), *M. latimanus* (von Martens, 1868), *M. microps* Holthuis, 1978, and *Palaemon concinnus* Dana, 1852, which are reported here. Six species had previously been recorded: *M. aemulum* (Nobili, 1906), *M. australe* (Guérin-Méneville, 1838), *M. caledonicum* (J. Roux, 1926), *M. equidens* (Dana, 1852), *M. lar* (Fabricius, 1798) and *Palaemon debilis* Dana, 1852, bringing the total fauna to ten species. A key is provided to the freshwater Palaemonidae of New Caledonia.

KEY WORDS
Crustacea, Decapoda, Palaemonidae, *Macrobrachium*, *Palaemon*, New Caledonia, Indo-West Pacific, new records.

RÉSUMÉ
Additions à l'inventaire de Palaemonidae (Crustacea, Decapoda) d'eau douce de Nouvelle-Calédonie. Un inventaire effectué sur plus de trente-cinq rivières de la Grande Terre et sur quelques grottes de Lifou (archipel des Îles Loyauté) a permis de recenser quatre espèces signalées pour la première fois en Nouvelle-Calédonie : *Macrobrachium grandimanus* (Randall, 1839), *M. latimanus* (von Martens, 1868), *M. microps* Holthuis, 1978, et *Palaemon concinnus* Dana, 1852. Six autres espèces avaient été recensées auparavant : *M. aemulum* (Nobili, 1906), *M. australe* (Guérin-Méneville, 1838), *M. caledonicum* (J. Roux, 1926), *M. equidens* (Dana, 1852), *M. lar* (Fabricius, 1798) et *Palaemon debilis* Dana, 1852. Le nombre total d'espèces inventoriées s'élève dorénavant à dix. Une clé de détermination des Palaemonidae d'eau douce de Nouvelle-Calédonie est proposée.

MOTS CLÉS
Crustacea, Decapoda, Palaemonidae, *Macrobrachium*, *Palaemon*, Nouvelle-Calédonie, Indo-ouest Pacifique, nouveaux signalements

INTRODUCTION

The freshwater Palaemonidae of New Caledonia were first studied by J. Roux (1926) based on collections made by Roux and F. Sarasin in 1911 and 1912. Three species were reported, including one new to science. Kamita (1967) published an account of the freshwater shrimps collected by the 1958 Osaka Melanesia Expedition but included no new records or species of Palaemonidae. The most detailed survey of the freshwater shrimps of New Caledonia was conducted by the Zoological Institute of the University of Vienna in 1965 led by Professor Dr Ferdinand Starmühlner. In all, 124 stations were sampled in mainland New Caledonia. This material was studied by Holthuis (1969) who listed three new records of Palaemonidae.

The present report is largely based on collections made between September and October 1991 throughout mainland New Caledonia (project PEDCAL). A total of thirty-five river catchments were investigated (Marquet 1996). Later a number of other rivers of "*Grande Terre*" (surveyed by G. M.) and a few caves on Lifou, in the Loyalty Islands (first by B. Séret, ORSTOM, then by G. M.), were also investigated. In total, this collecting campaign yielded four new records of freshwater Palaemonidae.

MATERIALS AND METHODS

The present material was collected by electrofishing in rivers and using baited traps in caves. The majority of specimens have been lodged in the Muséum national d'Histoire naturelle, Paris (MNHN), with the remainder in the Queensland Museum (QM). Specimen lengths are carapace length (CL) from the orbital margin to the posterior carapace. The second pereiopods (large chelipeds) are abbreviated as P2.

The presence or absence of a pre-anal carina is introduced as an important character for distinguishing species of *Macrobrachium* Bate, 1868. Although the morphology of the pre-anal carina has been widely used in atyid taxonomy it does not appear to have been utilized for palaemonids. The carina is found on the sclerite between the ventral uropods, hereby termed the inter-uropodal sclerite, as it does not appear to have been named previously in the literature. Unlike many features of *Macrobrachium* morphology the presence or absence of a pre-anal carina does not change significantly during development and is present in both sexes. It is therefore a very useful key character.

The morphology of the epistome, sometimes used as a taxonomic character in other decapod groups, is also introduced here for distinguishing species in the genus. This structure shows more developmental variation than the pre-anal carina but can sometimes be used to discriminate between otherwise similar species and is useful for both sexes.

Another useful character not widely used for distinguishing species is the shape of the inferior orbit. In most species this is reasonably consistent between the sexes and at different stages of development.

These new characters have been used in the following key to New Caledonian freshwater Palaemonidae. Unlike previous keys to *Macrobrachium* this key can be used for all adult specimens, not just mature male specimens with fully developed second pereiopods. Regrettably, it was still necessary to use the morphology of the second pereiopods to some extent (often broken off during the process of preservation and handling), but this has been kept to a minimum and fully developed males (often a small percentage of material collected) are not obligatory for accurate determinations.

Key to the freshwater Palaemonidae of New Caledonia

1. Anterior carapace with hepatic spine; P2 hypertrophied in developed males, covered in numerous modified setae (spinules, tubercles, spines of previous authors) .... *Macrobrachium* 3

— Anterior carapace with branchiostegal spine; P2 similarly developed in both sexes, smooth, not covered in numerous modified setae .... *Palaemon* 2

2 (1). Upper antennular flagellum with fused portion clearly less than half length of shorter free ramus; first male pleopod with vestigial appendix interna .... *P. concinnus*

— Upper antennular flagellum with fused portion over half length of shorter free ramus; first male pleopod without appendix interna .... *P. debilis*

3 (1). Pre-anal carina absent on inter-uropodal sclerite (between ventral uropods) 4

— Pre-anal carina well-developed on inter-uropodal sclerite 5

4 (3). Second pereiopods of developed males strongly dimorphic, differing in shape, size and setation; inferior orbit obtuse .... *M. grandimanus*

— Second pereiopods of developed males isomorphic; inferior orbit distinctly angular .... *M. equidens*
(Freshwater records generally restricted to areas under tidal influence. More typically an inhabitant of mid to high salinity estuarine areas.)

5 (3). Ocular cornea well-developed; fourth abdominal pleura posteroventrally rounded or bluntly angular 6

— Ocular cornea reduced; fourth abdominal pleura posteroventrally acute .... *M. microps*

6 (5). Adult P2 merus clearly longer than carpus 7

— Adult P2 merus about equal to or clearly shorter than carpus 8

7 (6). Epistome lobes poorly-developed, low and rounded, not produced anteroventrally in adults; P2 stout, chela without enlarged incisor tooth on each finger in developed males .... *M. latimanus*

— Epistome lobes strongly-developed, produced anteroventrally in adults; P2 elongate, chela with enlarged incisor tooth on each finger in developed males .... *M. lar*

8 (6). Epistome lobes strongly diverging and widely separated anteriorly .... *M. aemulum*

— Epistome lobes not strongly diverging anteriorly, poorly to moderately separated 9

9 (8). P2 manus clearly longer than dactylus, subcylindrical on major chela of developed males, minor cheliped pubescent on all segments .... *M. australe*

— P2 manus *ca.* equal to or clearly shorter than dactylus, markedly broadened on major chela of developed males, minor cheliped of developed males without setal pubescence .... *M. caledonicum*

SYSTEMATICS

Macrobrachium grandimanus (Randall, 1839)
(Figs 1C-E, 2)

Restricted synonymy:

Palemon (sic.) *grandimanus* Randall, 1839: 142.

Macrobrachium grandimanus – Holthuis 1950:14, 110 (key), 230-233; 1973: 23-24, text-fig. 7; 1980: 92. – Choy 1984: 272.

Not *Macrobrachium grandimanus* – Liang & Yan 1983: 214, 215, fig. 3. – Liu *et al.* 1990: 103 (key), 113, 114, fig. 11.

MATERIAL EXAMINED. — **Wé.** New Caledonia, Lifou Island, 20°55'S - 167°15'E, in large cave in coconut plantation at border of the sea, netted, 28.VIII.1993, B. Séret, ORSTOM: 1 specimen (MNHN Na13286); 1 ♀, 10.7 mm CL (QM W20013).
Luengoni. New Caledonia, Lifou Island, 21°02'S - 167°25'E, at entrance of cave, netted, 25.VIII.1993, B. Séret, ORSTOM: 2 specimens (MNHN Na13287).

DISTRIBUTION. — Previously recorded from the Ryukyus, the Philippines, Hawaii and Fiji.

DIAGNOSIS
Rostrum of medium length in developed males, with well developed dorsal and ventral carinae, dorsal margin generally straight or slightly convex, occasionally sinuous or upturned, armed with fourteen to fifteen (rarely up to seventeen) teeth, four to five postorbital, teeth more or less evenly spaced, ventral carina with three to five (rarely up to seven) teeth, first tooth located in proximal half or at mid-length of carina.
Ocular cornea large, well-pigmented. Inferior orbit moderately produced, generally obtuse, postantennular carapace margin convex. Epistome distinctly bilobed, lobes widely separated, rounded.
P2 of developed males fully dimorphic, short, minor cheliped reaching tip of scaphocerite by carpus or more distal segments. Major cheliped

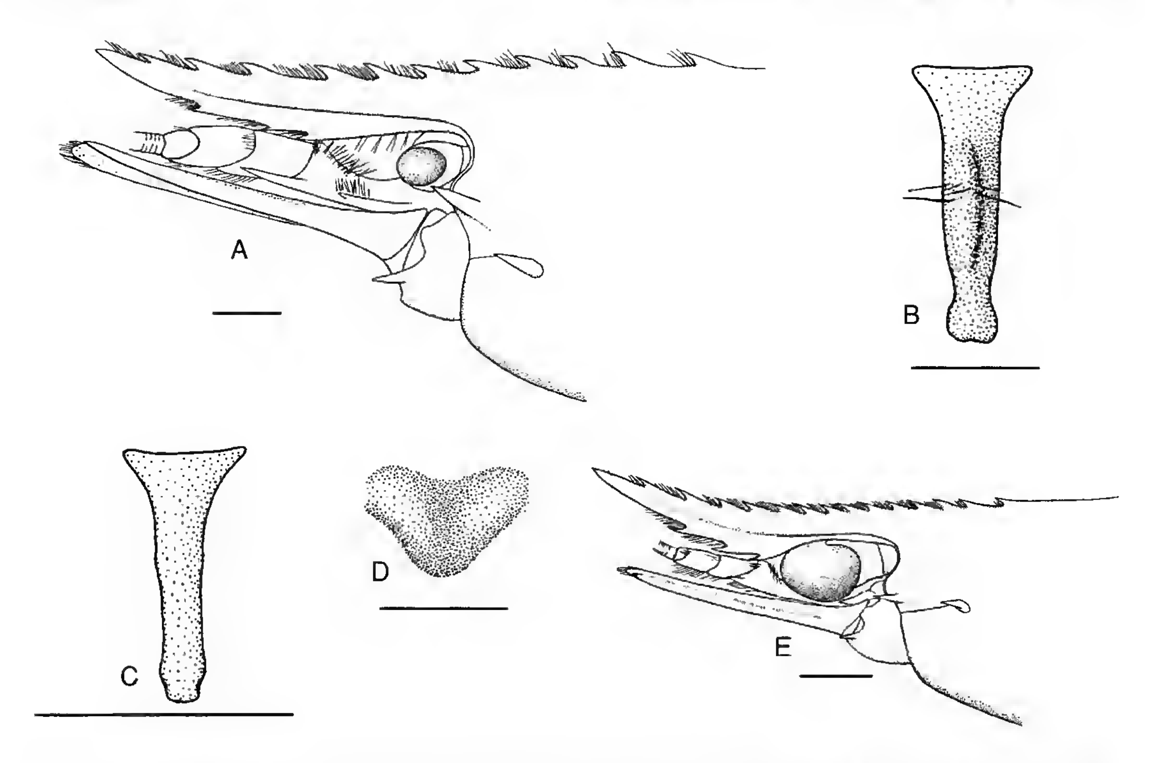


FIG. 1. — **A**, **B**, *Macrobrachium microps* Holthuis, 1978, ♂ (21.6 mm CL); **A**, anterior carapace; **B**, inter-uropodal sclerite; **C-E**, *M. grandimanus* (Randall, 1839), ♀, 10.7 mm CL; **C**, inter-uropodal sclerite; **D**, epistome; **E**, anterior carapace. Scale bars: A, E, 2 mm; B-D, 1 mm.

with well-developed setal pubescence on manus, chela with well-developed gape between fingers, opposable edges armed with small to moderately large teeth along length and a large incisor tooth, manus broadened, maximum breadth much greater than maximum breadth of merus; carpus clearly shorter than chela; merus *ca.* equal in length to carpus. Minor cheliped without setal pubescence, chela with well-developed gape between fingers, opposable edges of fingers dentate proximally, distally entire, manus clearly shorter than dactylus, slightly broadened; carpus clearly shorter than chela; merus *ca.* equal in length to carpus.

Thoracic sternite 4 with well-developed median process. Fourth abdominal pleura bluntly angular posteroventally, fifth pleura acutely angular posteroventally, inter-uropodal sclerite without pre-anal carina.

REMARKS

M. grandimanus has previously been recorded from anchialine caves in the Hawaiian Islands (Holthuis 1973). The present records are all from caves adjacent to the sea which were fresh at the time of collection. It is local knowledge that the water level rises in these caves when the tide is very high but undetermined whether the water becomes brackish.

Although the collection does not include a developed male, the characteristic rostrum with many, more or less evenly-spaced, dorsal teeth, the lack of a pre-anal carina, the shape of the inferior orbit and the widely separated epistome lobes are sufficient to confirm the identity of the species.

Liang & Yan (1983) recorded as *M. grandimanus* a species from Hainan Island, China. However the second pereiopods do not agree with typical

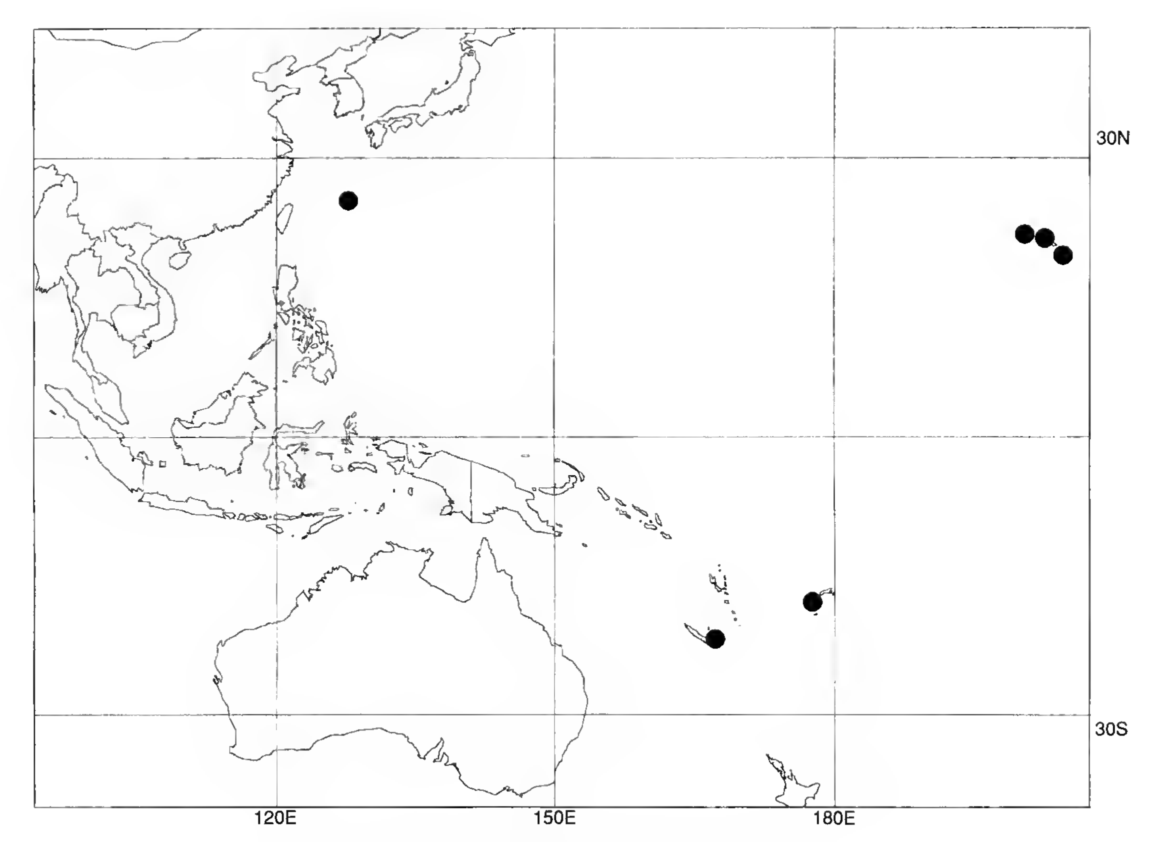


FIG. 2. — Distribution of *Macrobrachium grandimanus* (Randall, 1839).

M. grandimanus. Liang & Yan's illustration shows a distinctive setal pubescence which continues from the superior manus onto the proximal pollex. In *M. grandimanus* the setal pubescence is restricted to the proximal half of the manus. Liu *et al.* (1990) also figured a specimen which agrees closely with Liang & Yan's. This species appears to be undescribed.

Macrobrachium latimanus
(von Martens, 1868)
(Fig. 3)

Restricted synonymy:

Palaemon latimanus Von Martens, 1868: 44.

Macrobrachium latimanus – Holthuis 1950: 16, 109 (key), 205-209, fig. 43a, b; 1980: 97, 98. – Tiwari 1955: 233, fig. 2; 1961: 98-104, figs 1, 2. – Costa 1979, pl. 1d. – Hwang & Yu 1982: 171, text-fig. 11, pl. III fig. B. – Chace & Bruce 1993: 23 (key), 31-32, fig. 11.

MATERIAL EXAMINED. — **Napoemien River.** New Caledonia, PEDCAL stn 17, 20°58'S - 165°20'E, altitude 165-200 m, river breadth 2 m, water temperature 19 °C, depth 0.5 m, electrofished, 15.IX.1991: 1 specimen (MNHN Na13288).
Padyeem River, New Caledonia, 20°34'S - 164°48'E, depth 0.2 m, electrofished, 6.VI.1997, G. Marquet: 1 ♂, 23.5 mm CL, 2 ♀♀, 17.1, 20.5 mm CL (QM W22255).

DISTRIBUTION. — Wide-ranging Indo-West Pacific, from India and Sri Lanka to the Ryukyus Islands and the Marquesas Islands.

DIAGNOSIS

Rostrum short in developed males, with well-developed dorsal and ventral carinae, dorsal margin generally convex, occasionally sinuous, armed with six to twelve teeth, one to two post-orbital, teeth tending to be more closely spaced distally than proximally above orbit; ventral carina dentate, two to four teeth, generally unarmed on proximal half with first tooth located clearly within distal half.

Ocular cornea large, well-pigmented. Inferior

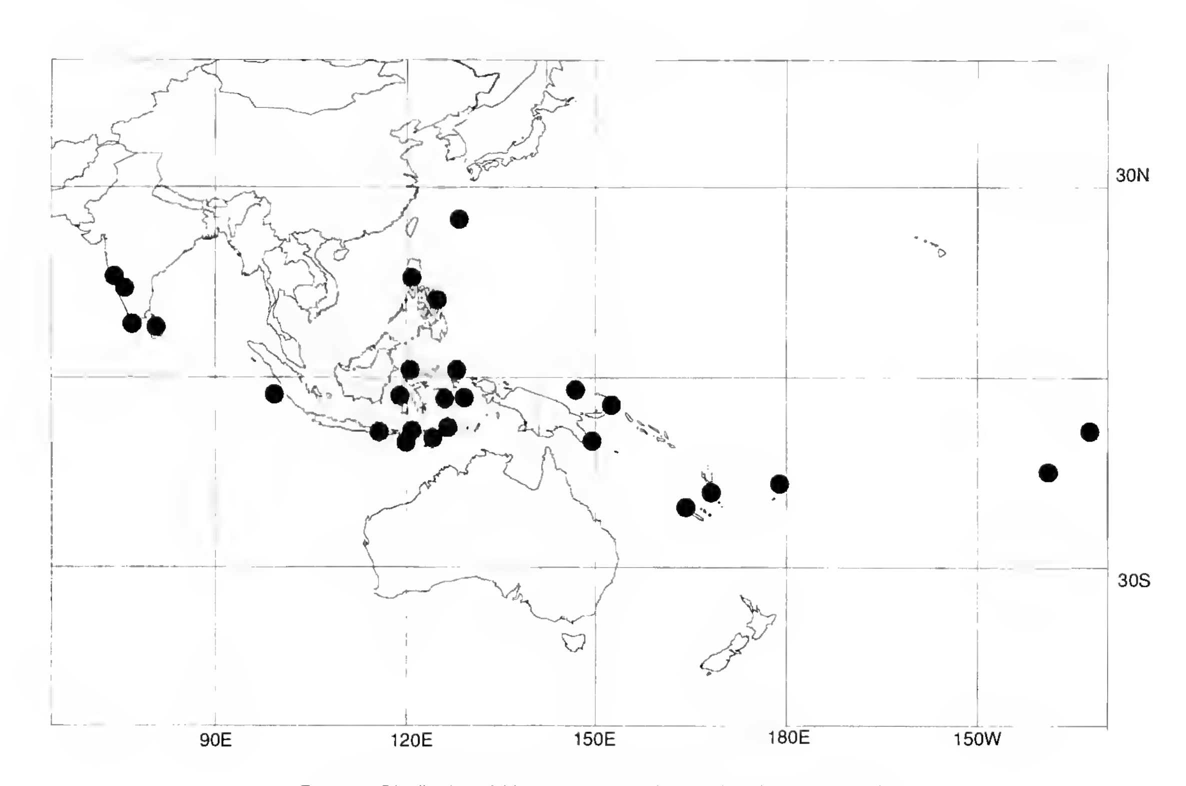


FIG. 3. — Distribution of *Macrobrachium latimanus* (von Martens, 1868).

orbit moderately produced, obtuse, postantennular carapace margin evenly rounded. Epistome distinctly bilobed, lobes rounded, widely separated.

P2 of developed males isomorphic (may be subequal in length), long, merus reaching tip of scaphocerite; chela with weak gape, short setal pubescence on manus and fingers, manus moderately broadened, breadth clearly greater than maximum merus breadth, manus clearly longer than dactylus; carpus clearly shorter than chela; merus clearly longer than carpus.

Thoracic sternite 4 with well-developed median process. Fourth abdominal pleura bluntly angular posteroventrally, fifth pleura angular posteroventrally, inter-uropodal sclerite with elevated pre-anal carina.

REMARK

This species appears restricted to mountain streams in the higher rainfall areas of eastern New Caledonian *e.g.* Napoemien River in the north and the Rivière du Trou bleu in the south (photograph sent to J. S. for identification by Christine Pöllabauer, Erbio, Nouméa).

Macrobrachium microps Holthuis, 1978
(Figs 1A, B, 4)

Macrobrachium microps Holthuis, 1978: 210-214, figs 1, 2. – Bruce & Iliffe 1993: 83-96, figs 1-6.

MATERIAL EXAMINED. — **Luengoni.** New Caledonia, Lifou Island, 21°02'S - 167°25'E, cave, trapped, 29.XII.1994, G. Marquet: 2 ♂♂, 21.6, 23.1 mm CL (QM W19913).

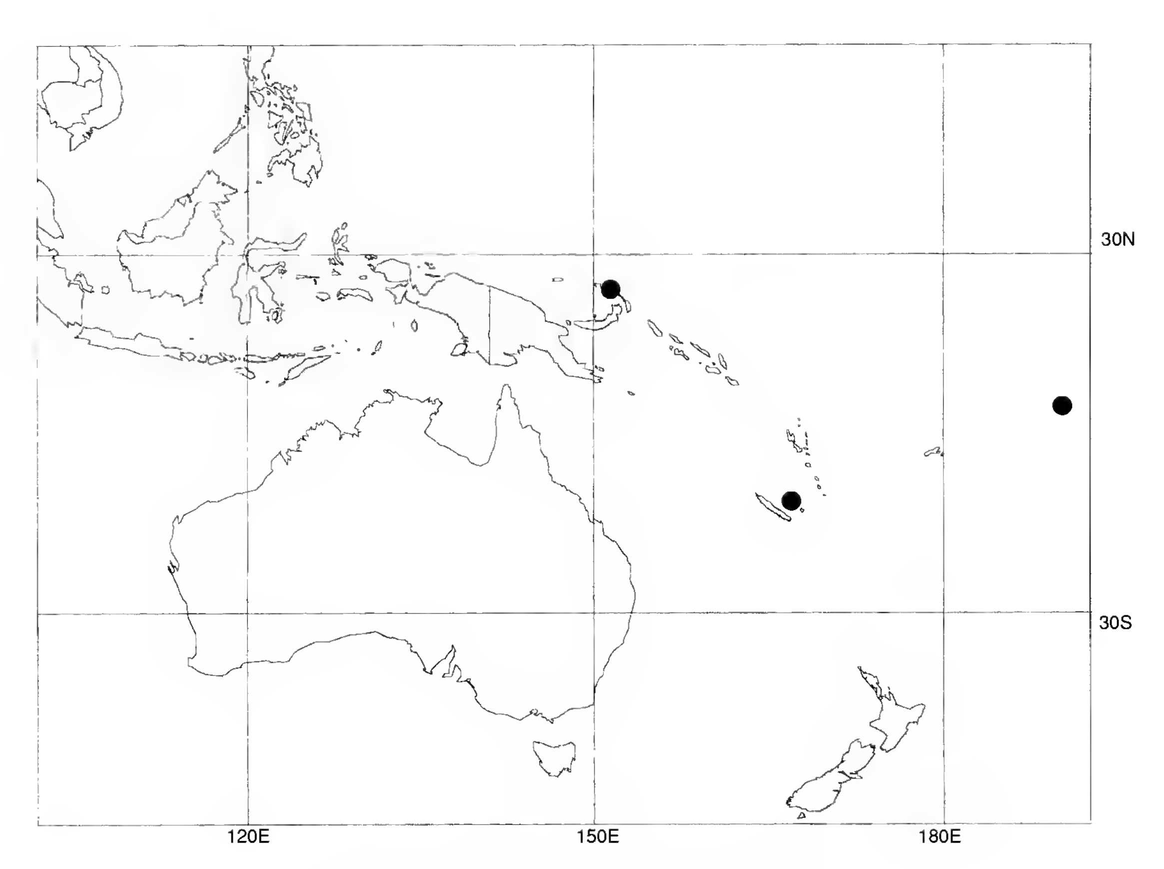


FIG. 4. — Distribution of *Macrobrachium microps* Holthuis, 1978.

Distribution. — Previously recorded from the type locality Danmin Cave, near Konogusgus, New Ireland and West Samoa.

Diagnosis

Rostrum short in developed males, with well-developed dorsal and ventral carinae (ventral carina sometimes reduced), dorsal margin slightly sinuous, armed with ten to eleven teeth, four to five postorbital, teeth more or less evenly-spaced, ventral carina with three to four teeth, first tooth located in proximal half to about mid-length.

Ocular cornea reduced, but well-pigmented. Inferior orbit obtuse, postantennular carapace margin evenly rounded. Epistome distinctly bilobed, lobes rounded, widely separated.

P2 of developed males fully dimorphic, short, minor cheliped reaching scaphocerite by carpus or more distal segments. Major cheliped without setal pubescence, chela without gape between fingers, manus broadened, maximum breadth much greater than maximum merus breadth, strongly inflated at mid-length; carpus clearly shorter than chela; merus *ca.* equal in length to carpus or slightly shorter. Minor cheliped without setal pubescence, chela with well-developed gape between fingers, manus moderately broadened, breadth clearly greater than maximum merus breadth, clearly shorter than dactylus; carpus clearly shorter than chela; merus slightly shorter than carpus.

Thoracic sternite 4 with low median boss. Fourth abdominal pleura posteroventrally acute, inter-uropodal sclerite with elevated pre-anal carina.

Remarks

The present material, which does not include a fully-developed male, agrees with the two previously known specimens in the following unique combination of characters for the genus: fourth and fifth abdominal pleurae posteroventrally acute; ocular cornea reduced, but well-pigmented; and the obtuse, evenly rounded, inferior orbit. Rostrum morphology also falls within the previous range of variation recorded for the species.

Although nothing is known of the life cycle of *M. microps*, the present distributional records suggest recruitment of juveniles from haline waters and an extended, planktonic larval cycle rather than a land-locked life cycle.

Palaemon concinnus Dana, 1852

Restricted synonymy:

Palaemon concinnus Dana, 1852: 26. – Chace & Bruce 1993: 40. – Short 1995: 622.

Palaemon (*Palaemon*) *concinnus* – Holthuis 1950: 61, fig. 12.; 1980: 109.

Material examined. — **Néra River.** New Caledonia, 21°36'S - 165°27'E, nerted, 29.V.1995, G. Marquet: 4 ♂♂, 9.4-10.6 mm CL; 1 ovig. ♀, 11.1 mm CL; 1 non-ovig. ♀, 11.3 mm CL (QM W20738).

Distribution. — Wide-ranging Indo-West Pacific: Eastern Africa to Hong Kong, the Philippines, Australia and the Tuamotu Archipelago.

Diagnosis

Carapace armed with submarginal branchiostegal spine. Rostrum long, with well-developed dorsal and ventral carinae, dorsal carina sinuous or upturned, with distinct unarmed region, bearing five to eight teeth, one tooth postorbital, ventral carina dentate, three to seven teeth.

Ocular cornea large, well-pigmented. Inferior orbit strongly produced, bluntly angular, postantennular carapace margin straight. Antennule upper flagellum with fused portion less than half total length of shorter free ramus. Vestigial appendix interna present on first male pleopod.

Remarks

This widely-distributed species is an inhabitant of both lowland fresh and brackish waters.

DISCUSSION

The New Caledonian freshwater palaemonid fauna, which now totals ten species in two genera, is comparable to the ten species (plus one introduced species, *M. rosenbergii*) recorded from neighbouring Fiji (Choy 1984). Interestingly, there are three wide-ranging, Indo-West Pacific

species recorded from Fiji, but so far absent from New Caledonia, viz. *M. gracilirostre* (Miers, 1875), *M. lepidactyloides* (de Man, 1892) and *M. placidulum* (de Man, 1892). It is likely that at least one of these will be found during future collecting campaigns.

It is also interesting that all but one New Caledonian species, *M. caledonicum* (J. Roux, 1926), the only endemic, are wide-ranging in the Indo-West Pacific. No large-egged, oligohaline palaemonids have so far been recorded from New Caledonia or from the other islands of Oceania. This contrasts with the larger continental land mass of Australia, directly west across the Coral Sea, which has four large-egged, oligohaline species of *Macrobrachium*, viz. *M. australiense* Holthuis, 1950; *M. bullatum* Fincham, 1987; *M. handschini* (J. Roux, 1933); and one undescribed species (Short unpublished data).

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Munidopsis reynoldsi (A. Milne Edwards, 1880) (Crustacea, Decapoda, Galatheidae): lectotype designation and redescription

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KEY WORDS
Munidopsis,
squat lobster,
deep-sea,
benthos,
Caribbean Sea.

ABSTRACT
A lectotype for the deep-sea squat lobster *Munidopsis reynoldsi* (A. Milne Edwards, 1880) from the Caribbean region is selected herein. The female lectotype is redescribed and illustrations of the types are given. Comparison with and illustrations of a non-type male from the Caribbean is also included.

MOTS CLÉS
Munidopsis,
océan profond,
benthos,
Caraïbes.

RÉSUMÉ
Munidopsis reynoldsi *(A. Milne Edwards, 1880) (Crustacea, Decapoda, Galatheidae) : désignation d'un lectotype et redescription.* Un individu femelle est choisi comme lectotype de *Munidopsis reynoldsi*, espèce profonde des Caraïbes. Ce spécimen est redécrit et illustré, et comparé à un mâle non-type.

INTRODUCTION

Munidopsis reynoldsi was originally described as a species of the genus *Galathodes* A. Milne Edwards, 1880 on the basis of two specimens, the male MCZ 4747 and the female MNHN-Ga 288, both from the *Blake* station No. 138, 1878-1879 (Peirce & Patterson 1879). It was described in only a few lines: "*Cette espèce doit se placer à côté du* Galathodes abbreviatus, *mais elle s'en distingue par ses épines gastriques plus saillantes, par son rostre plus relevé, par l'absence d'épines sur les anneaux de l'abdomen et par la longueur des pattes ambulatoires ; celles de la seconde paire dépassent les pinces, leur cuisse est armée en dessus d'une série d'épines*" (A. Milne Edwards 1880: 56).

Because no holotype was designated, a lectotype for *M. reynoldsi* is selected herein. The female syntype (MNHN-Ga 288) is better preserved than the male syntype and is here chosen. The male (MCZ 4747) is the paralectotype. Opportunity is taken here to elaborate on the taxonomy of this deep-sea species, providing a redescription of the female lectotype and illustrations of the types. Comparison with and illustration of a non-type male from the Caribbean is also included.

ABBREVIATIONS

MCZ	Museum of Comparative Zoology, Cambridge;
MNHN	Muséum national d'Histoire naturelle, Paris;
TA&M	Texas A&M Oceanography Collections;
stn	station;
cl	carapace length measured on the midline of the carapace from the tip of the rostrum to the posterior margin of the carapace;
cw	maximum carapace width;
mm	millimeters.

Munidopsis reynoldsi (A. Milne Edwards, 1880) (Figs 1-4)

Galathodes Reynoldsi A. Milne Edwards, 1880: 56.

M. (*Galathodes*) *Renoldsi* [*sic.*] – Henderson 1885: 414.

Munidopsis reynoldsi – A. Milne Edwards & Bouvier 1894: 225, 273, 275 [key]. – Benedict 1902: 325 [synonymy]. – Chace 1942: 74 [key]. – Pequegnat & Pequegnat 1970: 139 [key]; 1971: 5 [key], 22 [synonymy].

Munidopsis Reynoldsi – A. Milne Edwards & Bouvier 1897: 80 [redescription], pl. 6, Figs 1-5.

Munidopsis Reynoldsii – Doflein & Balss 1913: 176, 178 [distribution].

MATERIAL EXAMINED. — **Caribbean Sea.** *Blake*, stn 138, off Saint Croix, Frederickstadt, 4277 m, 1878-1879: ♀ lectotype, cl 20.8, cw 11.4 (MNHN-Ga 288); ♂ paralectotype, cl 16.0, cw 9.0 (MCZ 4747). — *Alaminos*, Cruise 70A10, stn 48, 14°29.5'N - 74°28.8'W, 4086 m, 24.VII.1970: 1 ♂, cl 20.4, cw 11.0 (TA&M 2-0597) (W. E. Pequegnat and L. H. Pequegnat det.).

DISTRIBUTION. — Caribbean Sea: off Saint Croix, Frederickstadt; Colombian Basin (14°29,5'N - 74°28,8'W), 3700-4277 m.

REDESCRIPTION (lectotype female)

Carapace distinctly longer than broad (rostrum excluded), moderately arched transversely; cervical groove well distinct, conspicuous shallow transverse depression in anterior part of cardiac region. Rostrum curved upwards, narrow, lateral margin with acute spines directed forwards, tip exceeding eyestalks by about four times their length, distinct dorsal carina bearing obsolescent tiny tubercles. Anterolateral angle a sharp spine. Gastric region strongly inflated; anterior gastric region bearing sharp spine on both sides of midline, and posterior to each another less developed spine; remainder of gastric region with short tubercles. Anterior branchial region bearing strong anterolateral spine followed by scattered moderate acute tubercles dorsally. Posterior branchial region bearing strong anterolateral tooth and distinct oblique and transverse rugae laterally; rugae with tendency to being transversely continuous across central part of cardiac region. Posterior margin concave, preceded by narrow raised ridge with tiny tubercles. Lateral plate with small rounded tubercles, projecting anteriorly below antennal peduncle; angular anterior tip bearing distinct spine.

Abdominal somites unarmed; transverse ridge of segment 2 smooth, divided into anterior and posterior parts by concave trough, that of seg-

ments 3 and 4 obsolescent; segments 5 and 6 smooth, 6 slightly raised posteriorly in middle. Telson divided into eight plates.

Eyes small; well exposed, ommatidia almost absent; peduncle movable, extended into strong smooth mesiodorsal spine directed obliquely upward at low angle; a much shorter lateral spine near base of cornea.

Basal article of antennular peduncle with slender dorsolateral carina continued into anterior acute spine; below it a broader anterior sharp spine directed obliquely laterally, flanked by inflated surface bearing cluster of irregular spinules.

Antennal peduncle with fixed short basal article; subsequent articles movable, second bearing sharp spine on its anterolateral angle, third with serrate distal margin and acute spine on its mesiolateral angle.

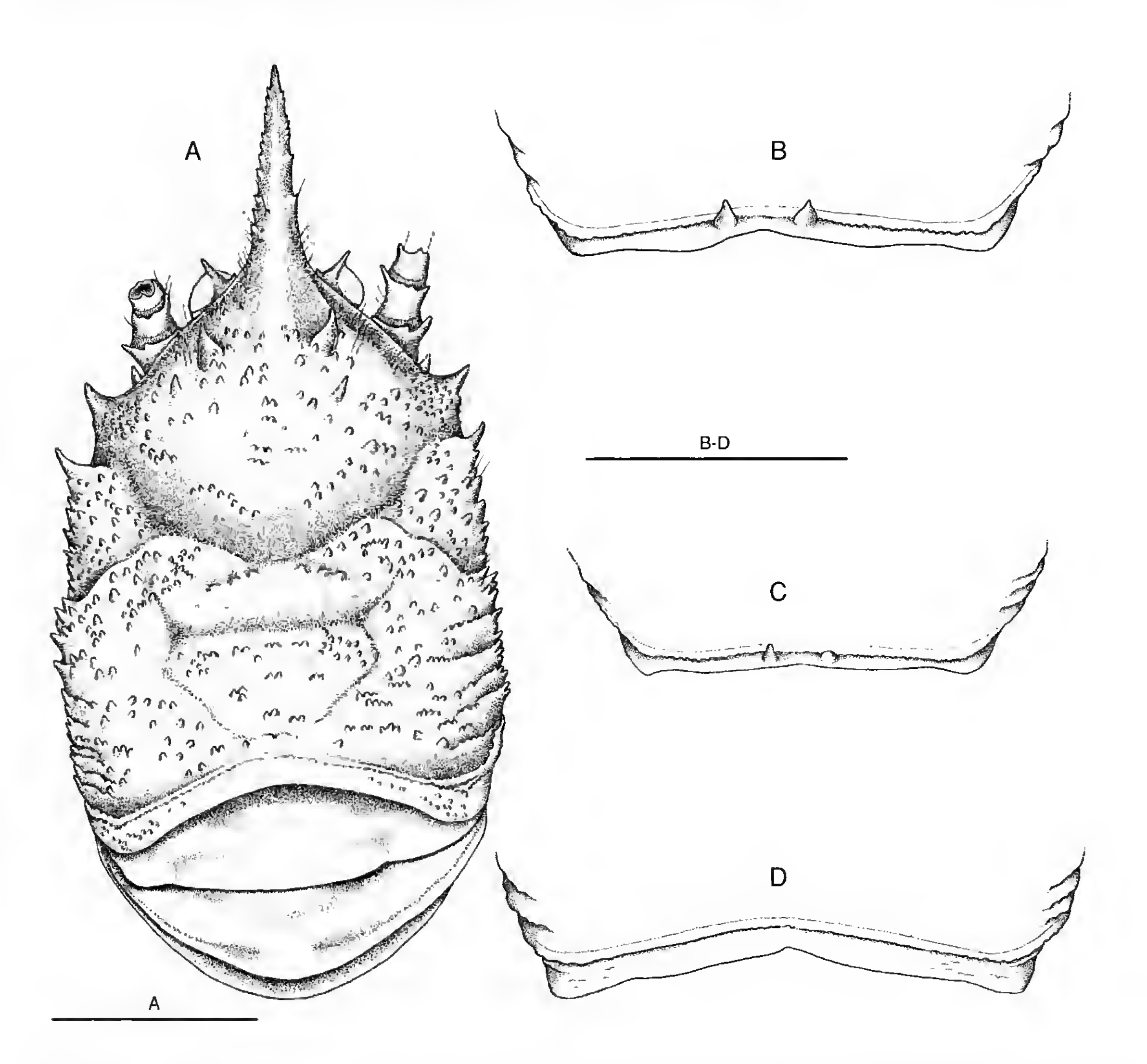


FIG. 1. — *Munidopsis reynoldsi* (A. Milne Edwards, 1880); **A**, dorsal view of the lectotype ♀ (MNHN-Ga 288); **B-D**, schematic view of the posterior margin of the carapace; **B**, ♂ from the *Alaminos* Cruise (TA&M 2-0597); **C**, paralectotype ♂ (MCZ 4747); **D**, lectotype ♀ (MNHN-Ga 288). Notice the two spines of the posterior margin of the carapace much more stronger in the male from the *Alaminos* collections, poorly developed in the male paralectotype and absent in the female lectotype. Scale bars: 5 mm.

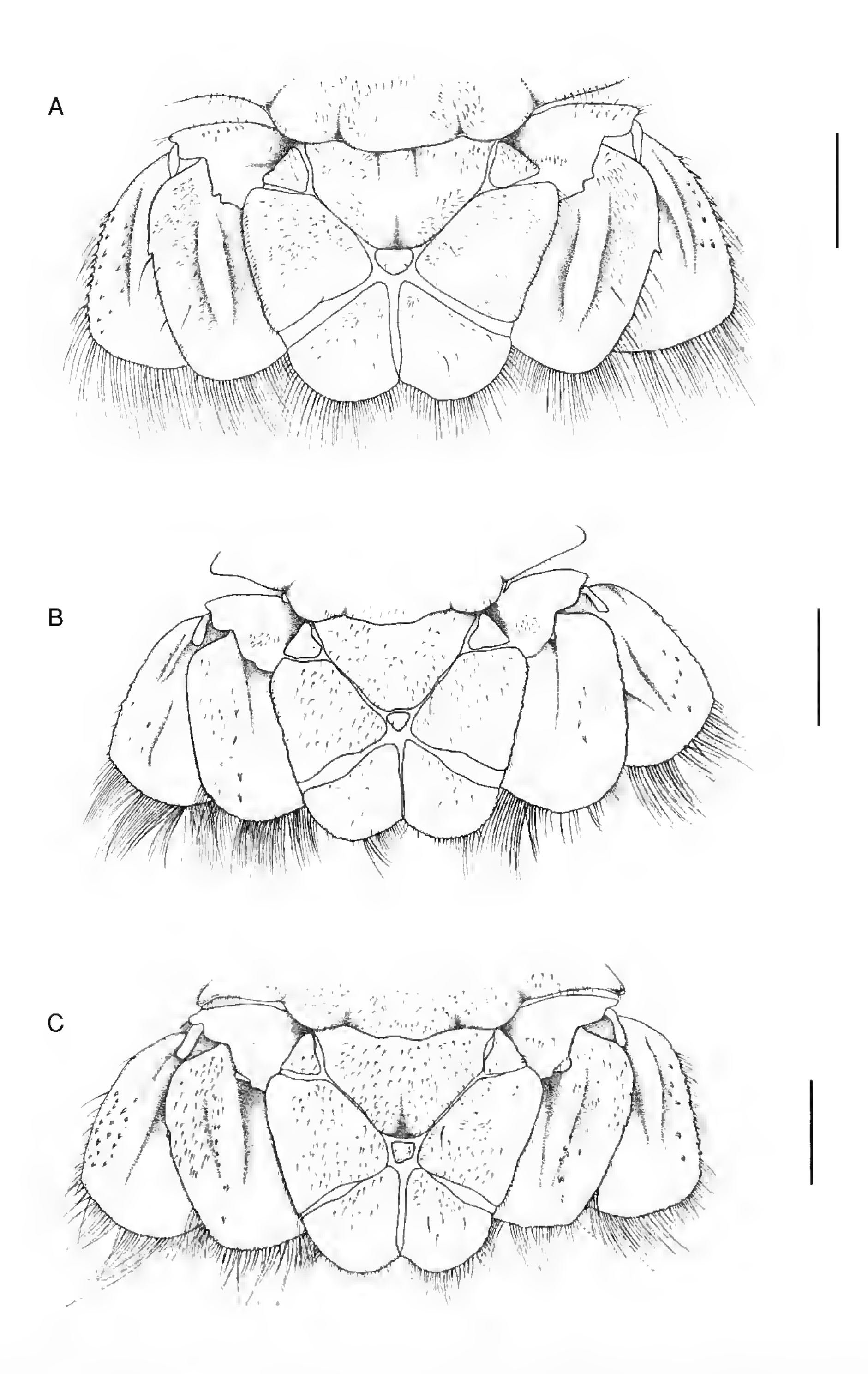


FIG. 2. — *Munidopsis reynoldsi* (A. Milne Edwards, 1880), dorsal view of the uropods, telson plates and posterior margin of abdominal segment 6; **A**, male from the *Alaminos* Cruise (TA&M 2-0597); **B**, paralectotype ♂ (MCZ 4747); **C**, lectotype ♀ (MNHN-Ga 288). Scale bars: 2 mm.

Third maxilliped with ischium longer than merus; bearing mesial crest armed with finely uniform, evenly-spaced corneous-tipped spines. Merus with four irregular acute spines on flexor margin. Carpus, propodus and dactyl about as long as two more proximal articles together, flexor surface of each bearing dense setation mesially, and distally on propodus and dactyl. Sternite at base of third maxilliped forming opposed lobes on each side of midline, irregularly serrate on margin and divergent.

Chelipeds subequal, with many spines and fewer acute tubercles; ischium with mesial row of seven rounded spines, irregular smaller spines on disto-ventral margin, and scattered tubercles and rugosities ventrally; merus clearly extending beyond end of rostrum, bearing row of four strong mesial spines, terminal one strongest, five to six spines along lateral margin; carpus spiny on ventral surface tending to smooth; mesial and lateral

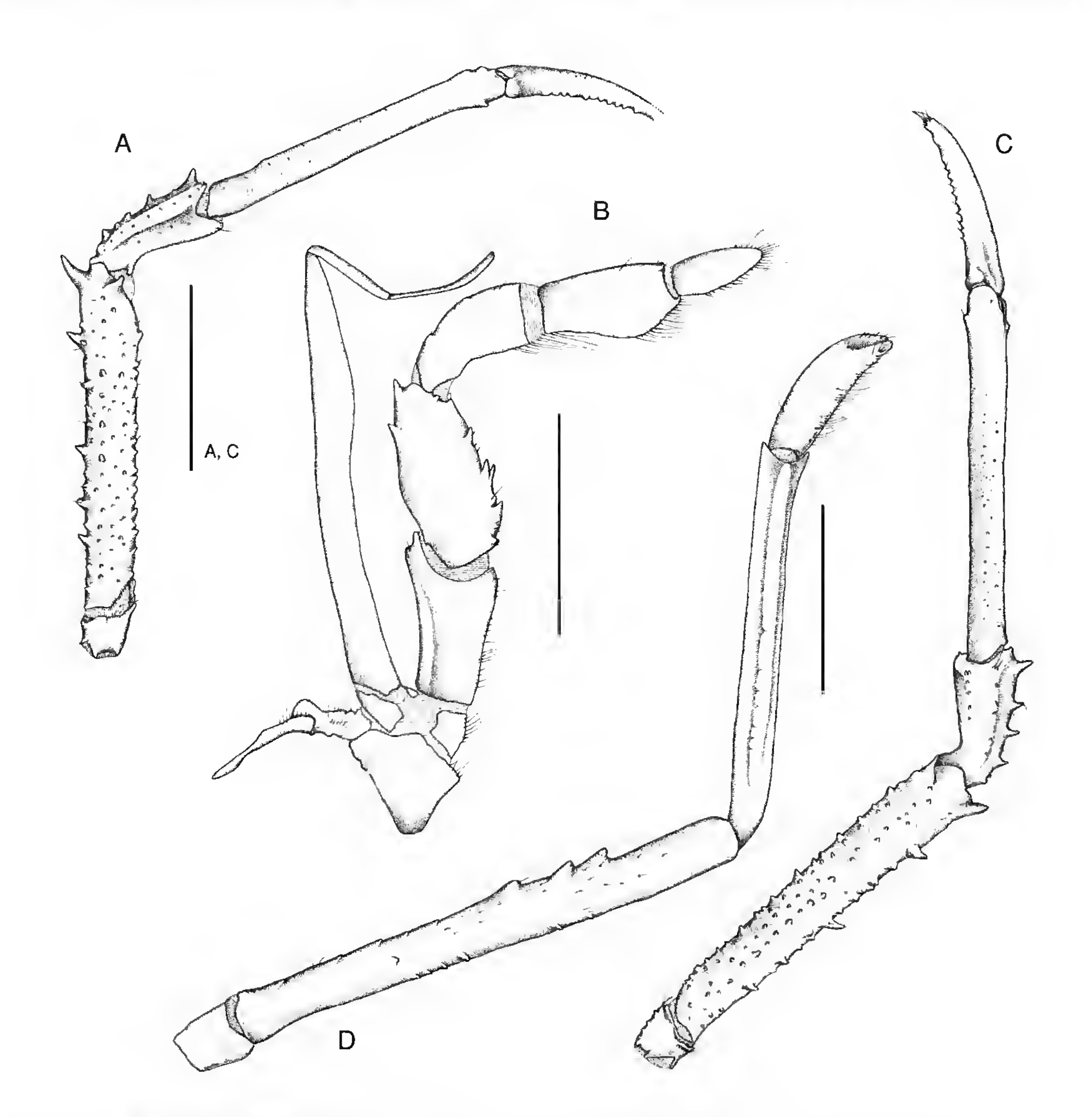


Fig. 3. — *Munidopsis reynoldsi* (A. Milne Edwards, 1880), external view of the third maxilliped (Mxp3) and thoracic appendages from the paralectotype ♂ (MCZ 4747); **A**, right P3; **B**, left Mxp3; **C**, left P3; **D**, left P5. Scale bars: A, C, D, 5 mm; B, 6 mm.

surfaces of palm with short scattered tubercles; fingers about as long as palm, spooned especially at tips, prehensile edges armed with rounded teeth, tips close fitting. Epipods absent from chelipeds and all walking legs.

VARIATIONS

The unique specimen caught by the RV *Alaminos* (TA&M 2-0597) is considerably larger than the type material, both male and female. Pequegnat & Pequegnat (1971: 22) found that the *Alaminos* material "is more hirsute" than the male paralectotype. The two spines of the posterior margin of the carapace are much stronger in the male from the *Alaminos* collections than in the male paralectotype; they are absent in the female lectotype. Also, the two gastric spines are more prominent in the *Alaminos* specimen than

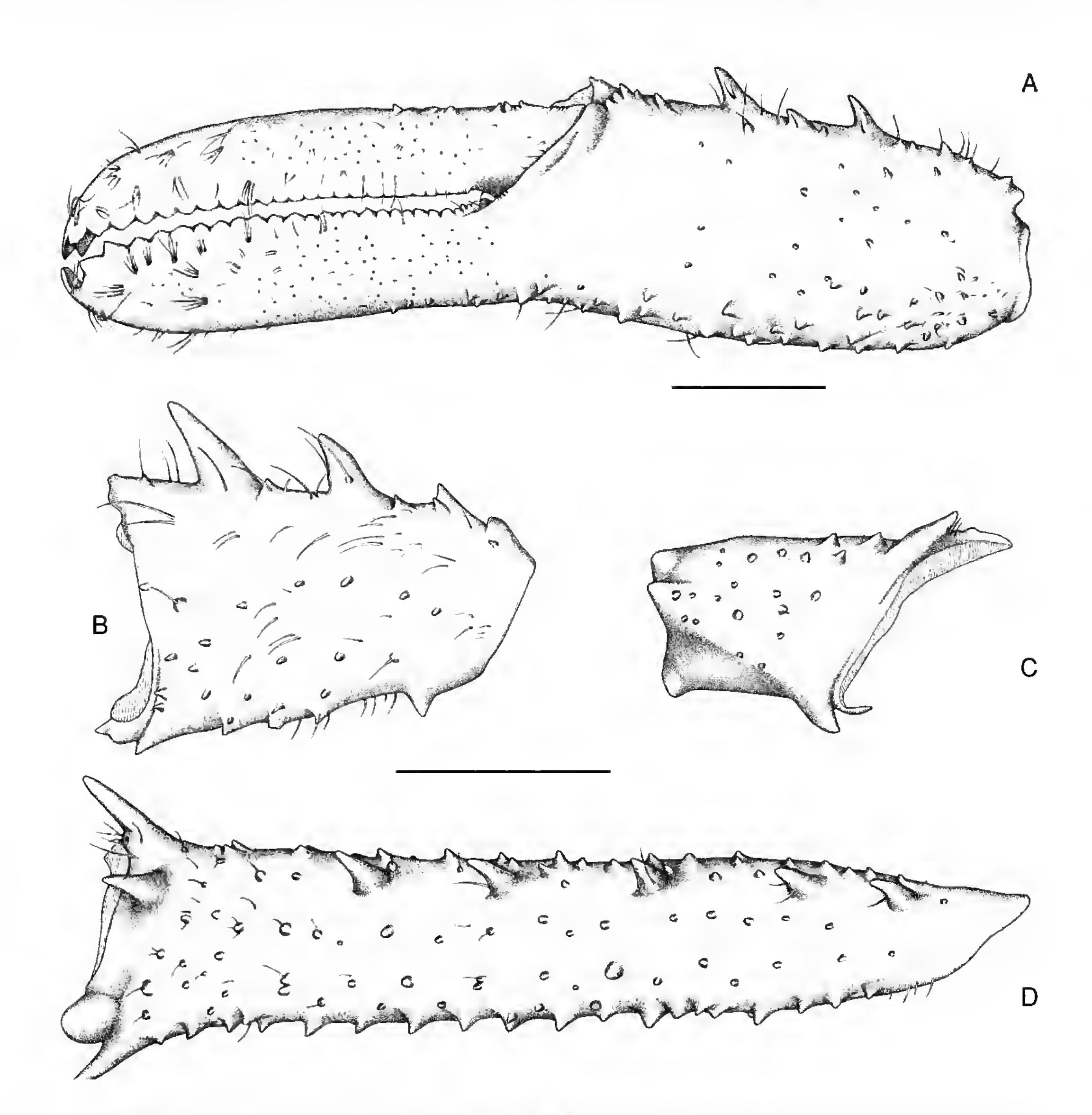


FIG. 4. — *Munidopsis reynoldsi* (A. Milne Edwards, 1880), external view of left cheliped from the lectotype ♀ (MNHN-Ga 288); **A**, dactylus and propodus; **B**, carpus; **C**, ischium; **D**, merus. Scale bars: A, 4 mm; B-D, 6 mm.

in the types. However, the mesiodorsal spine of the ocular peduncle is far weaker in the *Alaminos* material than in the female lectotype, while in the male paralectotype the mesiodorsal spine of the ocular peduncle is slightly larger than in the *Alaminos* specimen.

REMARKS

In 1897, A. Milne Edwards & Bouvier briefly redescribed and illustrated the male and the female syntypes of *M. reynoldsi*. The illustration of the male (pl. 6, fig. 1) has two inaccuracies: (1) the two spines on the posterior margin of the carapace (Fig. 1B-D) in the male paralectotype are not shown on A. Milne Edwards & Bouvier's drawing (Pequegnat & Pequegnat 1971: 22); (2) the telson plates are not properly represented (this report), actually *M. reynoldsi* has eight telson plates instead of seven (Fig. 2A-C).

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